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A MONOGRAPH OF THE SECTION OREOCARYA OF CRYPTANTHA[1]

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Introduction

The group of plants treated in the present monograph is remarkably characteristic of the Upper Sonoran areas of the Great Basin region, although a few species are native to the eastern foothills of the Rocky Mountains, one or two have penetrated to the Canadian plains and two or three occur in northern Mexico and adjacent Texas. In western Colorado, Utah, Nevada, and southern Wyoming one or more species may be found on almost any barren hillside. Many seem to prefer soils that are so strongly impregnated with mineral salts that few other plants can compete with them. No species seems to be able to tolerate a moist or undrained situation.

These plants are often transient occupants of any habitat. They seem particularly at home on shifting or disturbed soil. A loose hillside or shale outcrop is a favorite locality for the commoner kinds. And yet they are never weeds in cultivated ground—that distinction is reserved for the annual members of the genus. What the factors are that determine this tendency to occupy changing habitats is as yet unknown to the author—one of many ecological problems suggested by the present study.

The members of the section *Oreocarya* are very similar in general appearance. They are usually gray with numerous trichomes and in most cases are beset with harsh bristles that render

[1] Issued October 8, 1927.

[2] Since the receipt of the manuscript of this paper, Dr. Payson passed away on May 15, 1927.

them unpleasant to human hands. As a group, these plants are inconspicuous in a country where inconspicuous plants are the rule. They are at home with various species of *Atriplex*, *Artemisia*, *Astragalus*, *Eriogonum*, *Abronia*, *Lesquerella*, *Physaria*, *Mentzelia*, *Ephedra*, *Townsendia*, and other similar forms. Many are rather regularly associated with the desert juniper (*Juniperus utahensis*) and the pinyon (*Pinus edulis*).

They are plants of the waste lands of the arid west; lands that are waste not because man has abandoned them but because he has never thought them worthy of his attention. From a conventional viewpoint these species are quite unattractive. Even in the largest-flowered species one can scarcely imagine them being gathered for ornamental purposes. They are neither sufficiently bizarre to render them noteworthy, sufficiently troublesome to make them objects of concern, nor common enough near the habitations of men to have merited for them the distinction of a common name.

In spite of the apparent unattractive nature of these plants they are of remarkable taxonomic interest. As a group they are not easily distinguishable by superficial peculiarities but possess technical characters of rather remarkable constancy. The geographical distribution of the species is decidedly interesting. Many are very local, and most conform very closely to natural areas. The present study has shown that this group of plants exhibits phylogenetic tendencies of importance to students of evolution in the flowering plants. Doubtless certain features of their ecological relationships would offer a promising field for further studies.

Phylogeny

I. The section Oreocarya

The author finds that the most successful method of attack on any phylogenetic problem comes from comparing closely related forms. Some at least of the species that occupy contiguous areas and differ only by minor characters may be thought to stand in the father-son relationship to one another. Occasionally, even, we may expect to find series of three species that stand in the grandfather-father-son relationship. Various con-

siderations of age, variability, stability of environment, etc. may be expected to influence the nature of the descendants, but it does not seem probable that these disturbing factors will so confuse the phylogenetic pattern as to make it entirely unintelligible. Even if of two, or three, closely related species no one represents exactly the ancestral form it will often happen that one remains more primitive than the other, and consequently the direction of evolutionary change will be quite as evident as though one species had remained stationary while the other diverged. If, by studying closely related forms, it can be discovered which is the ancestor and which the descendant, or which the primitive member and which the specialized one, evidence may be gained for use in building a theory of phylogeny. If one bit of such evidence is consistent with another gained from a consideration of other characters, then the hypothesis gains in stability. In this way, and piece by piece, the evolution of the twigs may be interpreted, and finally by putting all the facts together it may be possible to make a very probable guess as to the evolutionary form of the branch as a whole.

The following examples will make clear how this method has been employed in the present case.

C. Palmeri and *C. Jamesii* var. *multicaulis* are very closely related forms. The differences between them are: (1) *C. Palmeri* lacks a circle of crests at the base of the corolla tube, while in *multicaulis* the crests are very well developed; (2) *C. Palmeri* has a much more conspicuously accrescent calyx than *C. multicaulis;* (3) in *C. Palmeri* the style is longer than in *C. multicaulis* and so also is the corolla tube in proportion to the corolla lobes. One of the best arguments for the derivative nature of any species is the absence of parts that are characteristic of the family to which it belongs. The lack of crests is such a character. Their presence is widespread in the family, and their loss is held to be a reduction pointing the direction of evolutionary change. The presence of accrescent calyx lobes in *Palmeri* strengthens the argument that *C. multicaulis* is a more primitive species than the other. It is now reasonable to suppose that in correlation with these characters, the other differences are significant as showing the course of change.

Another interesting pair of closely related species is *C. oblata* and *C. Jamesii* var. *multicaulis*. These are not so closely related as were the other pair and yet their relationship is quite evident. In the original description of *C. oblata*, M. E. Jones cited a specimen of *C. Jamesii* var. *cinerea* as typical of the new species. In comparing these two we notice the following significant differences:

C. oblata	*C. Jamesii* var. *multicaulis*
Crests lacking at base of tube	Crests present
Corolla tube exceeding the calyx	Corolla tube and calyx subequal
Calyx conspicuously accrescent	Calyx scarcely accrescent
Flowers heterostyled	Flowers uniform
Cymes contracted	Cymes elongating
Nutlets somewhat roughened dorsally	Nutlets smooth dorsally
Indument conspicuously setose	Setae less conspicuous

Following the lead given in the other case *C. multicaulis* may be considered primitive in having crests at the base of the tube and a scarcely accrescent calyx, while *C. oblata* is specialized in these characters. Nor is it unreasonable to think of roughened nutlets being more specialized than smooth ones and conspicuous setae developed later than the less setose trichomes. It now seems probable that the long corolla tube is derived from a shorter one and that heterostyled flowers have been developed from uniform flowers within the genus.

Other examples might be given. *C. confertiflora* and *C. flava* are very closely related and have been confused in the past with *C. leucophaea*. The relationship of these three species is so close that any one of them might be considered the ancestral form or that all three might have come from a very similar common ancestor. The latter supposition is the more probable. The phylogenetic conclusions will not be very different in either case.

C. confertiflora	*C. flava*	*C. leucophaea*
Crests usually evident	Crests usually obsolete	Crests usually evident
Conspicuously heterostyled	Conspicuously heterostyled	Less heterostyled

Nutlets ovate	Nutlets lanceolate	Nutlets ovate
4 nutlets mature	1–2 nutlets mature	3–4 nutlets mature
Flowers yellow	Flowers yellow	Flowers white

On the basis of the absence of crests in the corolla tube it may be concluded that *C. flava* is more specialized than are either of the others. When the data on the number of nutlets that mature are considered (and these data are very meager in the case of *C. leucophaea*) evidence is obtained for a belief in the primitive nature of *C. confertiflora* and *C. leucophaea* as compared with *C. flava*. Since the lanceolate nutlets are found in that form where one or two nutlets quite regularly abort, and the species with ovate nutlets usually mature all of their fruits, it is logical to consider the lanceolate nutlets as derived from the ovate ones because their occurrence in this trio is associated with another character about which there can be no doubt as to the phylogenetic interpretation. *C. leucophaea* seems to be less distinctly dimorphic in flower structure than is *C. confertiflora;* also the corolla tube is not so long, the flowers are white rather than yellow, and the indument less coarse. These are all characters that were thought of as primitive in connection with *C. Jamesii* var. *multicaulis* when contrasted with *C. oblata* and *C. Palmeri*.

It is of interest to make an especial study of those species that lack crests at the base of the tube. These species may be considered as specialized in that regard and since forms that are highly developed in one character may be expected to show recent rather than primitive qualities in other characters, it might be expected that on the whole the characters of this group of species would be specialized. The species that quite regularly lack crests at the base of the tube are: *Palmeri, echinoides, fulvocanescens, flavoculata, Bakeri, oblata, flava, paradoxa, Jonesiana, longiflora,* and *tenuis*. In addition to these, *confertiflora, Osterhoutii, Wetherillii,* and *mensana* have poorly developed crests or at times none at all. In the first group, those species that are usually without crests, all but one have corolla tubes that exceed the sepals. In the second group two have long corollas and two short ones. Considering both groups together, we have fifteen species of which twelve have long corollas and only three short corollas. Nine out

of the fifteen have distinctly heterostyled flowers. These three characters, long corollas, heterostyled flowers, and lack of crests at the base of the tube, were considered specialized when *C. oblata* was compared with *C. Jamesii* var. *multicaulis*. Some evidence has been obtained that confirms the earlier judgment.

If the group of fifteen species listed in the preceding paragraph is examined as to the relationship of the species involved, one interesting fact is evident. These forms are not considered as closely related among themselves. In other words, the group is almost certainly polyphyletic. *C. Palmeri, oblata, confertiflora* and *flava* belong to the series of which *C. Jamesii* is the primitive member. *C. Jonesiana, C. echinoides*, and *C. fulvocanescens* are related to *C. breviflora* in the short-flowered group. The remaining species are possibly closely related to one another but seem far removed from the *breviflora* or the *Jamesii* group. The conclusion seems evident that the fifteen species listed above comprise a highly specialized artificial group selected from several, perhaps three, natural groups. If this is the case, then heterostyly and the long corolla tube have been evolved more than once within the section *Oreocarya*.

The question of the primitive nature of the perennial or annual habit is of much interest. Morphologists, in general, seem to be of the opinion that the perennial and even the arborescent habit is primitive for the Angiosperms. With this generalization the present author is inclined to agree but he believes he has found good evidence for the primitive nature of the annual habit in the Cruciferae. Because of this apparent contradiction the question in the section *Oreocarya* has received particular attention. If *C. Sheldonii* and *C. Bradburiana* are compared, it is noticed that here are two very closely related species, of which one is perennial and the other biennial. The nutlets in the former are distinctly smoother, and consequently more primitive, than in the latter. The geographical location of *C. Bradburiana* on the periphery of the generic range makes it seem reasonable also to consider this species a recent derivative from *Sheldonii*—so recent a derivative indeed, that there are difficulties in the way of according it complete specific independence.

Such arguments as these might be continued to include all the

evidence at hand for the phylogenetic conclusions that have been reached. This, however, seems of rather doubtful value since any who may wish to challenge the conclusions will wish to review the details of specific differences throughout the section. Enough has been given to show the method of attack, and some evidence has been adduced for some of the more important conclusions. Without further justification, the following summary of phylogenetic conclusions will be presented. These generalizations are, of course, only expected to apply to the evolution of the section *Oreocarya* of *Cryptantha*.

1. Smooth nutlets are more primitive than roughened ones.

2. In the course of evolution the nutlets were first roughened on the dorsal surface and finally on the ventral surfaces.

3. The scar in the primitive nutlets was straight and narrow and without an elevated margin.

4. The nutlets of the more primitive species are attached to the gynobase at a lower point than in the specialized species. (This is in agreement with Dr. Ivan Johnston's theory of the phylogeny of the genera of this family—see Contr. Gray Herb. **74:** 14–19. 1925).

5. The ovate nutlets are more primitive than the elongated or lanceolate type.

6. The primitive corollas in this group were uniform and did not exceed the sepals.

7. Heterostyly has apparently been developed a number of times within the section and seems to be regularly associated with long corolla tubes.

8. Crests at the base of the corolla tube were present in the primitive species and have become obsolete in the more specialized ones.

9. The accrescent sepals denote specialized species, and those forms with sepals that enlarge but slightly in fruit are to be considered primitive in this regard.

10. The primitive inflorescence was confined to the upper part of the stem and was composed of conspicuously elongating scorpoid cymes. As development proceeded the cymes became shorter and the inflorescence tended to extend over more and more of the stem.

11. The rather slender unbranched tall stem is considered more primitive than the very stout stem or the short, branched one.

12. An extremely setose indument is thought to be a mark of specialization, and in like manner a very sericeous and uniform covering is a specialization in another direction.

13. The primitive species were perennials and the less enduring forms are specialized.

14. The linear-oblanceolate leaf is more primitive than the broader ovate or spatulate types.

II. THE GENUS CRYPTANTHA AS A WHOLE

A detailed study of each section of *Cryptantha* in which the evolutionary tendencies were traced from species to species and from group to group would prove of very great phylogenetic interest. When that study is made, then, and only then, will it be possible to discuss the phylogeny of the genus in a comprehensive way. However, even with only a superficial knowledge of the genus as a whole, certain conclusions seem certain enough to warrant some discussion of them.

Two of the sections are characterized by the absence of cleistogamous flowers. This is so evidently a primitive character that these two sections, *Oreocarya* and *Krynitzkia*, are considered the primitive sections of the genus. Of these two sections one, *Oreocarya*, is prevailingly perennial, the other prevailingly annual. On this basis, then, *Oreocarya* is to be considered the most primitive of the four. *Oreocarya* differs from *Krynitzkia* also in other ways that are significant. In the former the flowers are mostly large and the cymes are usually bracteate, while in the latter the flowers are usually minute and the cymes usually ebracteate. In *Krynitzkia* the nutlets are often heteromorphic, while in *Oreocarya* the nutlets may not all develop but there is no tendency to heteromorphism. All these differences go to show that *Oreocarya* is, as a whole, more primitive than is *Krynitzkia*. However, the section *Krynitzkia* may not be considered as made up merely of specialized descendants of recent species of *Oreocarya*. For one thing, the elongated cymes, a primitive character, that are so characteristic of *Krynitzkia* must be traced back to a primitive rather than to a specialized *Oreocarya* species or *Oreocarya* ancestor.

The other two sections of *Cryptantha*, *Geocarya* and *Eucryptantha*, are, as it was stated before, characterized by the presence of cleistogamous flowers. In the former these are highly specialized and curious structures from near the surface of the ground, in the latter they occur in the inflorescence or in the axils of the cauline leaves and are not so highly transformed. It seems evident that of the two, *Geocarya* is to be considered the most specialized section of the genus. Both *Geocarya* and *Eucryptantha* have perennial primitive representatives as well as annual specialized ones.

The author interprets these facts concerning the characteristics of the sections as follows:

The perennial species we now place in the Section *Oreocarya* are the most primitive we know in the genus. The most primitive of these is *C. Jamesii* var. *multicaulis*. This variety has so many primitive characters that it may be used to visualize the ancestral form from which the others developed without doing violence to the known facts of phylogeny. It would seem reasonable to suppose that the primitive *Oreocarya* species evolved in four rather distinct directions. The species of *Oreocarya* remained perennial and showed a marked tendency to develop larger flowers and to reduce the length of the cymes. This group is probably monophyletic in the sense that a single primitive species gave rise to several species that in their turn produced others. Development in another direction produced annuals very early in the history of the genus. These annuals showed a marked tendency to reduce the size of the flowers, differentiate the nutlets in a single flower, and to elongate the cymes. This group we now know as the section *Krynitzkia*. It is probably truly polyphyletic, and species grouped here have arisen independently from several perennial ancestors.

The development of cleistogamous flowers of the two kinds undoubtedly began before the perennial habit had been lost since both the sections *Geocarya* and *Eucryptantha* have primitive perennial members. These sections followed lines of development very similar to those of *Krynitzkia* and so the species of these three sections are very similar in appearance. It seems rather doubtful if *Geocarya* is polyphyletic because of the very peculiar

cleistogamous flowers common to the species. *Eucryptantha*, however, may have arisen a number of times from *Krynitzkia*—whenever cleistogamous flowers were developed.

III. THE MECHANISM OF EVOLUTION

It is the author's contention that a taxonomic and phylogenetic study furnishes one of the best backgrounds for an evaluation of various theories of the mechanism of evolution. To make the most of this opportunity the taxonomic-phylogenetic study should be followed by an investigation into the variability, heredity, ecology, etc., of the group of plants under consideration. In the present case this has not been done, and it is realized that any conclusions the author may have reached must be offered merely as suggestions. The following speculations are presented for what they may be worth.

Natural selection.—The species of the section *Oreocarya* are much too beautifully adapted to their surroundings to permit the theory of natural selection to be discarded in any consideration of the evolution of the group. However, when the differences between species are taken into account, it seems evident that natural selection has had little to do with the evolution of species. For example, it is hard to imagine that the difference between the muricate and rugose nutlets would have any survival value. Even the wings on such nutlets as *C. confertiflora* or *C. setosissima* scarcely seem to be large or efficient enough to be of real value to the species. The distribution of pustulate hairs on the surfaces of the leaves can hardly be supposed to determine whether a species will survive or not. Even though specific differentiation in *Oreocarya* may be non-adaptive yet it is quite possible that natural selection has been constantly operative in eliminating many evolving forms that were not nicely adjusted to their surroundings.

Geographical isolation.—The author is inclined to believe that geographical isolation has been one of the chief factors in speciation. The way in which species conform to natural areas in their distribution, the consistency with which closely related and incipient species occupy adjoining areas, and the trivial characters that distinguish species and varieties, all seem to argue in favor

of isolation, and in the present case mainly geographical isolation, as being one of the most important evolutionary factors.

The subject of Age and Area has been much discussed recently. The author can see no indication that there is any correlation between these two factors in the present group of species. The species that is considered most primitive, *C. Jamesii*, occupies the largest area of any species in the section. However, *C. flavoculata*, which is certainly one of the most specialized of all, occupies an area that is much larger than that occupied by most species. Although the comparative ages of the species have not been established, it might be expected that there is a close positive correlation between age and degree of specialization.

Orthogenesis.—The frequency with which orthogenetic explanations lend themselves to phylogenetic description seems to be impressing itself more and more upon those who are interested in evolutionary theories. Orthogenesis is a phenomenon of evolution and no explanation. There is, of necessity, nothing teleological about this mode of development. In the present study one very interesting tendency that may be considered orthogenetic seems to be in operation. This is the tendency for long-lived ancestral species to produce short-lived descendant species. In the section *Oreocarya* this tendency has certainly occurred several times independently although the annual habit has never been attained. The sections *Eucryptantha* and *Geocarya* exhibit the same tendency to reduce the length of life. Therefore, in looking over the genus as a whole it can be said that again and again long-lived species have given rise to shorter-lived ones. Is this an inherently orthogenetic tendency or is it to be interpreted merely as a general response to wide-spread conditions of a common habitat? The only approach to an answer that the author can give to this question at the present time is to call attention to the phylogeny of *Lesquerella*. Here is a genus of comparable size to the section *Oreocarya* that occupies an area, in North and South America, where very similar habitats prevail. In *Lesquerella*, the tendency that appears again and again as the species evolve is to increase the duration of life. In similar, and often identical, habitats two unrelated genera do opposite things: *Cryptantha* produces annuals or biennials again

and again, while *Lesquerella* produces perennials time after time. And yet the tendency is not absolute. At least one species in *Lesquerella*, *L. Cusickii*, has certainly been produced from perennial parents,[1] and it seems quite probable that in South America *Cryptantha argentea* and *C. amplexicaulis* have developed from annual parents.

Geographical Distribution

A careful study of geographical distribution is at once one of the most interesting and necessary parts of any taxonomic or phylogenetic monograph. It is of great interest because species must evolve in some relation to their distribution and theories of isolation are becoming of greater and greater importance. Geographical distribution is of great practical importance in determination of species, since closely related forms rarely exist in the same area.

In a genus previously studied, i.e., *Lesquerella* of the Cruciferae, there was a most interesting direct relationship between geographical distribution and phylogeny. In this case the primitive species are located rather near the center of distribution and the farther any species occurs from this central region the more likely is it to be specialized. In the present group of species, this relationship seems not to hold—or at least not to be conspicuous. The only explanation that suggests itself at present is that the section *Oreocarya* is too old to show such a relationship. In this connection it would be most interesting to study the distribution of the more specialized sections of the genus in order to discover if other relationships exist there.

A study of a map on which are plotted all the specific ranges reveals the fact that the center of distribution is in western Colorado and eastern Utah. A conspicuous area of concentration extends from northeast to southwest, from southern Wyoming to southern Nevada.

If the distribution of the genus *Cryptantha* as a whole is examined it is seen that the primitive section, *Oreocarya*, is confined (if we neglect one or two possible South American species) to

[1]See Payson, E. B. A monograph of the genus Lesquerella. Ann. Mo. Bot. Gard. 8: 104. 1921.

North America, and the most primitive species is in the southern part of the sectional range. The other sections have their most primitive species in South America. It would seem reasonable to suppose that the genus originated in the southwestern part of North America and in its perennial primitive form spread to the desert regions of Chile and Argentina. In that region it became differentiated into three main groups. The most primitive of these invaded North America as *Cryptantha* in the limited sense of recent American floras. The other somewhat more specialized sections have not spread beyond South America. Before any confidence could be placed in such a theory the other sections of the genus would have to be studied very carefully.

The Specific Concept

The attempt has been made in the present study to adopt a specific concept that is intermediate between extremes of segregation and of aggregation although it is recognized that the species are not of uniform value. In general it has been the policy to accept as a species any unit that could be distinguished from related groups by two or more constant differences of significant value, provided that intermediates were lacking between the groups, or that these intermediates were so few as to be considered relatively unimportant. If the differences between different groups are of very small size, or if numerous intermediates exist, then the units concerned are best treated as varieties.

A conservative attitude toward proposed species has been maintained in case the evidence at hand is rather meager. This has led to the retention of certain units as species when possibly they will eventually be accorded varietal rank only.

The author is firmly convinced that all the units that are here accorded taxonomic recognition are real genetic units of considerable size and distinctness. Further study may shift the status of the various groups but this will be only of minor importance.

The device given below has been employed to illustrate the specific concept and, at the same time, to indicate something of the relative value of the different units. It is to be understood that names associated in certain positions in this outline are not indications of new nomenclatorial combinations.

Species and subordinate groups that the author would recognize if a broader specific concept were employed	Species and subordinate groups as recognized in the present study	Species and subordinate groups as they might be recognized if the specific concept were smaller and the presence of intermediates ignored
Jamesii	*Jamesii*	
multicaulis	*multicaulis*	*multicaulis*
	laxa	*laxa*
	cinerea	*cinerea*
	disticha	*disticha*
		Jamesii
typica	*typica*	
abortiva	*abortiva*	*abortiva*
pustulosa	*pustulosa*	*pustulosa*
Palmeri	*Palmeri*	*Palmeri*
oblata	*oblata*	*oblata*
leucophaea		
confertiflora	*confertiflora*	*confertiflora*
flava	*flava*	*flava*
typica	*leucophaea*	*leucophaea*
salmonensis	*salmonensis*	*salmonensis*
stricta	*stricta*	*stricta*
? nubigena	*nubigena*	*nubigena*
Clemensae	*Clemensae*	*Clemensae*
setosissima	*setosissima*	*setosissima*
virgata	*virgata*	*virgata*
humilis		
insolita	*insolita*	*insolita*
virginensis	*virginensis*	*virginensis*
tumulosa	*tumulosa*	*tumulosa*
modesta	*modesta*	*modesta*
typica	*humilis*	*humilis*
? nubigena		
caespitosa	*caespitosa*	*caespitosa*
thyrsiflora	*thyrsiflora*	*thyrsiflora*
? elata	*elata*	*elata*
sericea	*sericea*	
	typica	*typica*
	perennis	*perennis*
? aperta	*aperta*	*aperta*
Bradburiana		
? elata		
? aperta		
rugulosa	*rugulosa*	*rugulosa*
interrupta	*interrupta*	*interrupta*
spiculifera	*spiculifera*	*spiculifera*
celosioides	*celosioides*	*celosioides*
Sheldonii	*Sheldonii*	*Sheldonii*
Macounii	*Macounii*	*Macounii*
sobolifera	*sobolifera*	*sobolifera*
typica	*Bradburiana*	*Bradburiana*
nana	*nana*	
commixta	*commixta*	*commixta*
Shantzii	*Shantzii*	*Shantzii*
	ovina	*ovina*
typica	*typica*	*nana*
cana	*cana*	*cana*
propria	*propria*	*propria*

Species and subordinate groups that the author would recognize if a broader specific concept were employed	Species and subordinate groups as recognized in the present study	Species and subordinate groups as they might be recognized if the specific concept were smaller and the presence of intermediates ignored
fulvocanescens		
breviflora	*breviflora*	*breviflora*
typica	*fulvocanescens*	*fulvocanescens*
echinoides	*echinoides*	*echinoides*
Jonesiana	*Jonesiana*	*Jonesiana*
longiflora		
Wetherillii	*Wetherillii*	*Wetherillii*
typica	*longiflora*	*longiflora*
? tenuis	*tenuis*	*tenuis*
Osterhoutii	*Osterhoutii*	*Osterhoutii*
paradoxa	*paradoxa*	*paradoxa*
Bakeri	*Bakeri*	*Bakeri*
flavoculata		
mensana	*mensana*	*mensana*
typica	*flavoculata*	*flavoculata*
		? cristata
		? Shockleyi

TAXONOMIC CHARACTERS OF SPECIFIC VALUE IN THE SECTION OREOCARYA

Nutlets.—Nutlet differences are remarkably constant between individuals of any species in this group. With rather few exceptions, it is possible to determine any species by means of a mature nutlet. Differences in the character of the surface are most important, although size, form of the scar, and outline are usually characteristic. Were the nutlet peculiarities the only differences that exist, the species would be doubtfully tenable as species. However, when the plants are well known certain other characters are evident that are correlated with nutlet characters as well as with geographical distribution.

Corolla.—Certain differences in the corolla are of great importance. The relative length of the corolla tube and calyx lobes is very constant for any given species. The form of the fornices, the presence or absence of crests at the base of the tube are valuable diagnostic characters. Two species have yellow corollas while all others have white ones. In a few the corolla tube is pale yellow. In most species the fornices are distinctly yellow.

Calyx.—The sepals offer a few valuable characters. The amount of elongation of the lobes after anthesis is comparatively

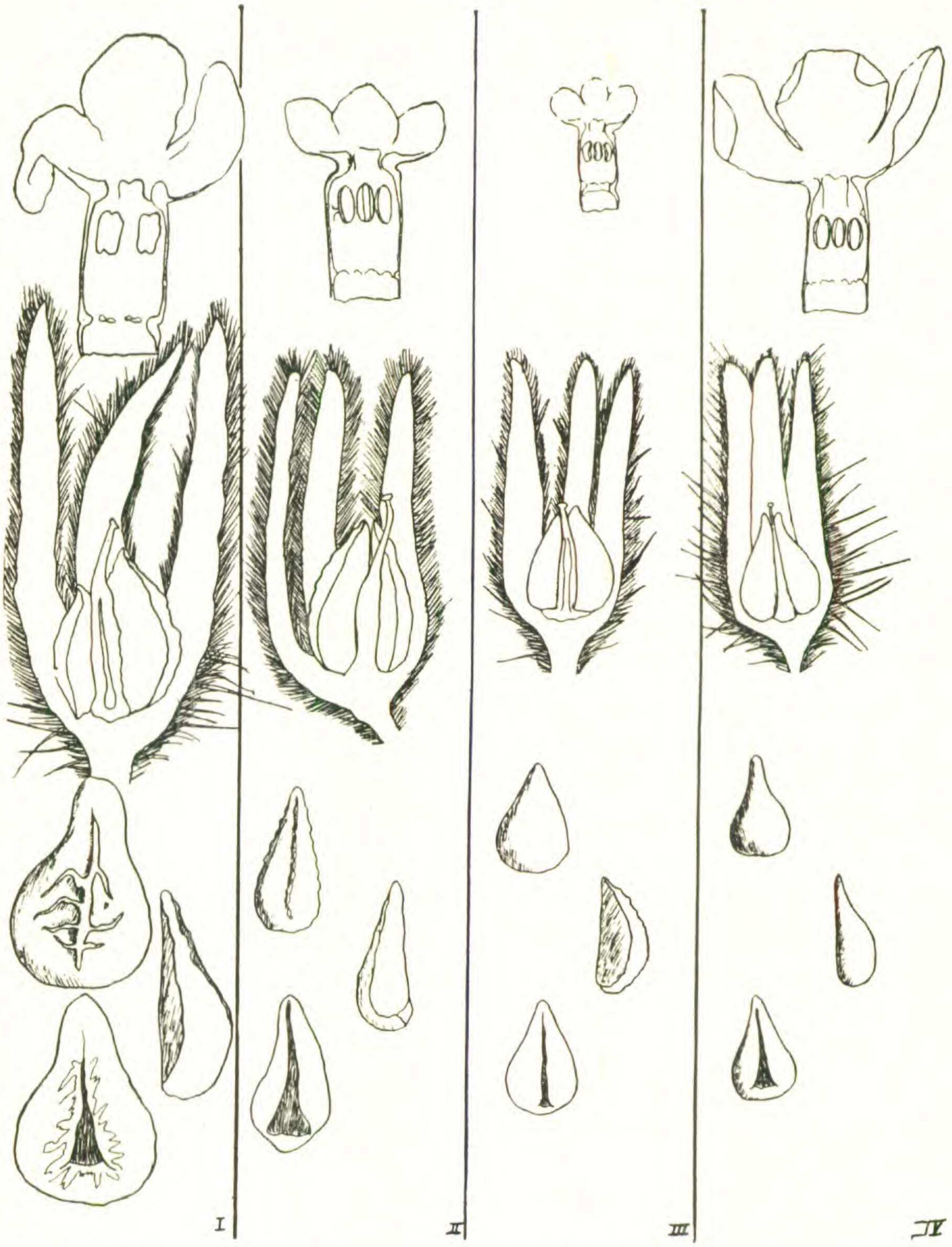


Fig. 1. Comparison of floral and fruit details of four species of *Cryptantha:* I. *C. virginensis*, section *Oreocarya;* II. *C. capituliflora*, section *Eucryptantha;* III. *C. Kingii*, section *Geocarya;* IV. *C. ambigua*, section *Krynitzkia.*

small in a few primitive species. Certain species have sepals that are nearly linear and in others they are fairly broad.

Style.—The length of the style, as well as the position of the stamens in the corolla tube, is of little specific value in the long-flowered species, since most of them are distinctly dimorphic in these characters. In the short-flowered species, however, the distance that the style exceeds the mature nutlets is of some value.

Indument.—Some species are characteristically setose and others conspicuously sericeous but most of the different forms are so similar in general hairiness that the differences are unnoticed by any one unfamiliar with the group. A few species are nicely characterized by the absence of pustulate hairs on the upper leaf surface, and one is peculiar in being nearly glabrous.

Inflorescence.—Differences in inflorescence are difficult of description. Most of the species are similar with respect to the manner in which the flowers are borne. A few have an unusual appearance because of the regular and extreme elongation of the cymes. One, *C. virgata,* is unique in the possession of elongated foliar bracts in an otherwise narrow inflorescence. Most of the species with a narrow inflorescence have a tendency to elongate the branches in age and so come to resemble those species with characteristically broad inflorescence.

Persistence.—A few of the species are evidently biennial and some are especially long lived. In general, differences in duration are not easy of definition and interpretation, and so these characters are only of exceptional value.

Leaves.—Leaf size and shape vary considerably between individuals and are ordinarily of little value in identification.

Stem.—Most of the species are similar with respect to the characters of the stem. A few are unusually tall and some are very low and caespitose.

Gynobase.—This structure is difficult of examination and in only a few species is it of diagnostic value. A series of careful drawings of the gynobase was made and these are available in the Rocky Mountain Herbarium.

THE GENERIC CONCEPT

One of the most important results of the present study has developed from a suggestion made to the author early in 1924 by Dr. Ivan Johnston of the Gray Herbarium. This was to the effect that *Oreocarya* could only with difficulty be maintained as a genus separate from *Cryptantha*. Since that time Dr. Johnston has continued his studies of the genera of this family and has become convinced that his earlier conjecture was correct. He has studied and collected plants of this relationship in South America as well as in western North America and has accumulated much evidence bearing on this point. Through the kindness of Dr. Johnston and of Dr. B. L. Robinson of the Gray Herbarium the author has been permitted to study a considerable series of South American specimens. This study, although much more superficial than that given to it by Dr. Johnston, has served to confirm his conclusions and to convince the author that as a genus *Oreocarya* can not be separated from the older *Cryptantha*.

In this enlarged sense, *Cryptantha* consists of about 150 species of the arid regions of western North and South America. These species are annual, biennial, perennial or even fruticose herbs with linear, oblanceolate, spatulate or nearly obovate leaves. Most of the species are clothed with a conspicuous indument of unbranched trichomes and all possess some enlarged epidermal pustules. The inflorescence consists of variously elongating, 2-ranked, scorpioid cymes. The sepals are persistent and usually somewhat accrescent in fruit. The corolla is salverform and white, white with yellow fornices, or entirely yellow in color. The fornices are always present at the throat of the corolla tube; a circle of crests at the base of the tube is present or absent. Nutlets are homomorphous or heteromorphous, one to four maturing, straight or nearly so, attached laterally to a subulate gynobase, smooth or variously roughened.

The considerations that have led the author to submerge *Oreocarya* into *Cryptantha* may be summarized as follows:

FUNDAMENTAL PREMISES

1. Genera can not be maintained that are only provincially distinct. In other words, genera should not be recognized in

one part of the world if they are not satisfactorily distinct in another.

2. It is admitted that genera are partly limited by a consideration of matters of convenience but fundamentally there must be some morphological character or characters on which to base genera.

3. If genera are based entirely on considerations of convenience, then taxonomic groupings will become so artificial and distorted as to furnish no sound basis for geographic or phylogenetic generalizations and taxonomy will become no more than a system of cataloguing.

4. Habital differences only may be of great value in specific or varietal distinctions but are not usually of generic value. Furthermore it is easy to say that this group differs from that in aspect but if this difference in aspect is not capable of morphological definition it can be accorded very little weight.

IMMEDIATE CONSIDERATIONS

5. The species of *Cryptantha* in South America, maintained by Johnston as valid, are about 40 in number. These include forms with considerable diversity of structure. There are forms with cleistogamous flowers of various kinds, others with only chasmogamic ones. There are fruticose, persistent, and annual species. However, the intermediates are so evident between the various categories that there seems no possibility of separating them except specifically. In South America, then, we have one genus.

6. It seems quite impossible to separate the annual North American Cryptanthas from the annual South American species except specifically. Some forms from the two continents are so similar that they could even be confused as belonging to the same species.

7. There are in South America a few species which in North America would unhesitatingly have been referred to *Oreocarya* because of floral and fruit characters as well as characteristic habit and aspect. These species are not aberrant Cryptanthas in South America.

8. The author has found it impossible to locate a single morphological character that will definitely separate *Oreocarya* and

Cryptantha when the South American species are taken into account. Even in North America the only character that has been found that will separate the two groups is the biennial or perennial root in *Oreocarya* and the annual one in *Cryptantha*.

9. From a standpoint of geographical distribution it is not remarkable to find a single genus common to western North America and western South America in Chile and Argentina. Many examples might be given: *Lesquerella mendocina* of northern Argentina, adjacent Chile and Bolivia is so similar to certain Rocky Mountain species as to make determination difficult if the labels are concealed; *Coldenia Nuttallii* is common to both continents with an enormous gap between (see Johnston, Contr. Gray Herb. **75**: 43–44. 1925); *Atamisquaea emarginata* is common to Lower California and to Chile.

If only the North American species were concerned, the author would keep the genera *Oreocarya* and *Cryptantha* as distinct on the basis of annual as opposed to perennial or biennial herbs. In addition, the inflorescence of *Cryptantha* is usually elongated and bractless while that of *Oreocarya* is usually contracted and bracteate. There are, however, many exceptions to these distinctions. The nutlets in the North American Cryptanthas show a strong tendency to definite heteromorphism, while in *Oreocarya* no such tendency has been noted. There are North American Cryptanthas with homomorphous nutlets. In some species of *Cryptantha* the calyx tends to fall as a unit and enclose the persistent nutlets. This has been given as a character distinguishing *Oreocarya* from *Cryptantha* but is not satisfactory, since many Cryptanthas do not shed their calyces and in one *Oreocarya*, at least, the pedicels have a tendency to separate from the stem and so drop the calyx with the persistent nutlets. This is *C. nana* var. *commixta*. Taking the South American species into consideration then, the one definite character separating *Cryptantha* from *Oreocarya* disappears entirely, and the union of the two groups becomes a necessity if the premises given above are worthy of acceptance.

The unfortunate result of uniting the Oreocarya group with the Cryptanthas comes because of the necessary shift in names. This seems unavoidable and is in the direction of simplification

rather than of complication. There has been much demand of late, on the part of taxonomists as well as non-taxonomists, for larger generic concepts and a consequent reduction in generic names. And it therefore happens that the change necessary in the present case is in line with tendencies that cannot be ignored.

Dr. Johnston (Contr. Gray Herb. **74:** 1–114. 1925) has reviewed the historical development of the genus *Cryptantha* (exclusive of *Oreocarya*) and has discussed the question of segregation and available generic names. This material need not be repeated here. Suffice it to say that the author accepts this treatment of the genus in North America as regards generic concept but would now add to it *Oreocarya.*

Taxonomic History of the Section Oreocarya

The first species belonging to this group to be described was *C. Bradburiana.* This was collected by Bradbury in "Upper Louisiana" in 1810 and described by Pursh as a species of *Cynoglossum* in 1814. In 1818 it was transferred to *Myosotis* by Nuttall. In 1828, a second species was described (*C. Jamesii*) and assigned to *Myosotis* by Torrey. Douglas described the third species (*C. leucophaea*) in 1830 and also placed it in *Myosotis.*

De Candolle in the 'Prodromus' transferred *Bradburiana* and *leucophaea* to the genus *Eritrichium* in 1846 and so started a treatment that persisted until 1885. During this period four species and two varieties were described in the group. The most important publication affecting the genus was by Gray in Proc. Am. Acad. **10:** 61. 1875. As a part of a revision of *Eritrichium* Gray grouped the known species and varieties together under the section *Pseudo-Myosotis* which had been proposed by A. De Candolle in the 'Prodromus' for *C. leucophaea.* Four species and three varieties were recognized as valid in this revision.

The next important treatment of this genus was by Gray in Proc. Am. Acad. **20:** 276–280. 1885. The species are here transferred to the section *Pseudokrynitzkia* of *Krynitzkia* with the exception of *C. setosissima* which was placed in the section *Pterygium.* The group was still held essentially as a unit and eight species were recognized that are now placed in the section *Oreocarya.*

The genus *Oreocarya* was proposed by Greene in 1887 (Pittonia **1**: 57–58) and made to contain nine species—eight of which are now held in this section. It is evident that this paper of Greene's is concerned with the question of the generic relationship of certain Boraginaceous plants rather than with specific determinations, since the species are those recognized by Gray as of this relationship in 1885. In 1896 Greene again published on this genus, and this time it was to describe eight new species and to redescribe several old ones. With this paper, Greene's most important contributions to the study of this genus end. In 1899 he described two new species and in 1901 two more.

The period from 1896–1915 is chiefly characterized by the appearance in literature of some thirty-five species proposed as new. These were proposed by a number of workers on the flora of the Rocky Mountains and the Great Basin, and except for those described by M. E. Jones were all assigned to the genus *Oreocarya*. The most active in this work of characterizing new species were Alice Eastwood, Aven Nelson, P. A. Rydberg, and M. E. Jones. In 1906 Rydberg published his 'Flora of Colorado' in which he recognized nineteen species as occurring in Colorado alone, and in 1909 Aven Nelson in the Coulter-Nelson 'Manual of the Flora of the Central Rocky Mountains,' maintained the same number of valid species for the whole region covered by the 'Manual.'

The first comprehensive revision of the group as included in the genus *Oreocarya* was published by J. F. Macbride in Contr. Gray Herb. **48**: 20–38. 1916. In this very excellent study forty-five valid species are maintained and differentiated by means of a dichotomous key. Specimens are cited under each specific name and comments are made relative to the different species. In 1918 Rydberg published a treatment of the species of the Rocky Mountain region in his 'Flora of the Rocky Mountains and Adjacent Plains.' In this he follows Macbride very largely but recognizes a few species that Macbride had not accorded specific rank. There are a few extra-limital species that Rydberg does not consider. However, he recognizes thirty-nine species in the range of his flora.

The history of *Oreocarya* subsequent to the important work done by Macbride in 1916 has been comparatively unimportant.

New species have been described from time to time by Osterhout, Brand, and Payson. The generic acceptance of *Oreocarya* has been almost universal since the genus was proposed until the present time. M. E. Jones and K. Brandegee seem to have been the only recent taxonomists who have refused to accept the generic separation of the perennial American forms (*Oreocarya*) from the annual species (*Cryptantha* or *Krynitzkia*). Their refusal to accept this segregation, it is of interest to note, was not based upon the most convincing evidence, i.e. the South American material, but upon the similarity of the North American species.

What the author believes to be the beginning of a new concept in the taxonomic treatment of the plants under consideration was made by Dr. Johnston in Contr. Gray Herb. **70**: 46. 1924, when he questioned the generic value of the Oreocarya group.

In summary, the history of this group may be said to reflect the history of taxonomy in America. First we notice the great increase in the number of described species. From two in 1828 the group has grown to eight in 1887, sixteen in 1896, sixty-two in 1916, and seventy-five in 1926. This increase shows two great factors at work. First is the great activity in exploration and description of species from the desert regions of western North America. Second is a tendency to reduce the value of a species. The generic shifts in the position of the species under consideration reflect another phase of taxonomic history. In the earlier treatments the species were placed under older genera to which they were not closely related. These associations proved unsatisfactory and so the species shifted until in *Krynitzkia* Dr. Gray thought he had associated them with their relatives—and so we think to-day. The author thinks there is no doubt but that Dr. Gray would have united *Krynitzkia* with *Cryptantha* if he had known the South American species as we now know them. This earlier period of taxonomic activity—ending with the work of Gray and Watson—was characterized by synthetic studies. Genera were revised as a whole and a great effort was made to arrange the groups so they might stand in the proper relationship to one another. Following this early period came a time of great expansion of population in the United States, and this was followed by a flood of floristic works on the plants of the regions so

newly occupied and colonized. Floras and manuals are notoriously provincial in their generic and specific concepts and so a great impetus was given to segregation of genera and species. Units were maintained in one region that could not be separated in another and there resulted a great confusion in the taxonomy of the plants of western America. This period of regional floras rather than of monographic work on whole genera or families seems now to be giving way to a period of synthetic and even experimental taxonomic work. With the great activity in the botanical exploration of South America, botanists must come to recognize that a local view of a genus is not sufficient and that before species or genera can be successfully characterized they must be seen in relation to all of their relatives. The union of *Oreocarya* and *Cryptantha* is a result of a larger systematic viewpoint and seems inevitable when such an enlarged view is obtained.

Illustrations

Since the nutlets present characters of the greatest taxonomic value, and since they are difficult of adequate description, it was thought worth while to illustrate all of those species in which the nutlets are significantly different. These drawings were made in pencil from the nutlets as seen through a binocular dissecting microscope giving a magnification of thirty diameters. Each nutlet is shown in three positions, and all were drawn twenty times the actual size. In reproduction this enlargement was reduced one-half. All the illustrations were prepared by the author.

Acknowledgements

The author is under great obligations to many people for assistance in the present work. Any taxonomic treatment borrows much from earlier workers. Sources of this kind are indicated in a bibliography. In the present case the revision by Mr. J. F. Macbride has been of the greatest value. That was the pioneer work that assembled the materials and made the present study much less difficult than it would otherwise have been. To Dr. Ivan Johnston and Dr. A. Brand the author is much indebted for

suggestions concerning the plants under consideration. Both of these workers are at present busied with studies in the *Boraginaceae*. Dr. Aven Nelson, Curator of the Rocky Mountain Herbarium, has done much to encourage and assist the author in many ways.

Herbarium material has been borrowed from a number of herbaria. Some collections have been visited by the author in person. To the curators of these various herbaria the author wishes to express his gratitude.

To Dr. George T. Moore, Director of the Missouri Botanical Garden, and to Dr. J. M. Greenman, Curator of the Herbarium at that institution, the author is under especial obligations for making possible the publication of this paper.

Specimens have been examined from the following herbaria, the abbreviations in parentheses being those used in the citation of specimens:

1. Colorado State Museum (Colo.).
2. Field Museum (Field).
3. Gray Herbarium (Gray).
4. Missouri Botanical Garden (Mo.).
5. Montana State College (Mont.).
6. New York Botanical Garden (N. Y.).
7. George E. Osterhout Herbarium (Osterh.).
8. Philadelphia Academy of Natural Sciences (Phila.).
9. Pomona College (Pomona).
10. Rocky Mountain Herbarium (R.Mt.).
11. United States National Herbarium (U.S.).
12. University of California (Calif.).
13. Victoria Memorial Museum, Ottawa (Canada).
14. Washington State College (Wash.).

Taxonomy

Dr. Ivan Johnston would divide the genus *Cryptantha* into three sections based upon the character of the flowers. To these three, the present author would add a fourth by dividing one of those maintained by Dr. Johnston. This classification may be indicated as follows:

Plant producing only chasmogamic flowers.
Perennial or biennial herbs, native to North America....Section I. *Oreocarya.*
Annual (or rarely perennial) herbs, native to North and South America
.....Section II. *Krynitzkia.*
Plant producing some cleistogamic flowers.
Cleistogamic flowers not highly specialized, differing from the chasmogamic ones merely in the closed corolla; borne in the axils of the cauline leaves and frequently in the spikes above.....Section. III. *Eucryptantha.*
Cleistogamic flowers highly specialized, becoming lenticular structures borne at the base of the stem.....Section IV. *Geocarya.*

The author proposed to retain *Oreocarya* as a section of *Cryptantha* for the following reasons:

1. The group of species that has been treated as comprising the genus *Oreocarya* is a fairly homogeneous unit rather easily separable from the other sections of the genus.
2. That it is not entirely and consistently separable from the other sections is an argument for its reduction from generic rank but is not a reason for failing to recognize it as a section.
3. As a matter of convenience, it is desirable to retain a name that has been so completely incorporated into literature as has *Oreocarya.* Since it can not be maintained as a genus, it is of some value to retain it in subgeneric rank.

In the present treatment the section *Oreocarya* is limited to the North American species. It is recognized that this is a more or less arbitrary division, and it might be argued that the separation would be better made to include all the perennial species without cleistogamic flowers. This would result in including at least one South American species, *C. gnaphalioides*, in the section *Oreocarya.* Two others might also be included, namely *C. argentea* and *C. amplexicaulis.* These two last ones are apparently more nearly related to some of the annual rather than to the perennial species and so would introduce an anomalous element into the section. The author believes that because the sectional separation must be made more or less arbitrarily, since no distinct line of cleavage exists, it is well to make it conform to distinct geographical lines. This seems particularly desirable since it is probable that even *C. gnaphalioides*, which species has the best right to be included in *Oreocarya* of all the South American forms, is probably more closely related to the annual Krynitzkias than to the perennial North American Oreocaryas. If it were certain

that a perfectly phylogenetic classification would result from dividing the sections strictly according to morphological characters, then there would be no question as to the preferable procedure. As it is, the sections are convenient, mainly monophyletic, groups, and the question of expediency has a right to consideration.

CRYPTANTHA section **OREOCARYA** (Greene) Payson new comb.

Eritrichium, section *Pseudomyosotis* A.DC. Prodr. **10:** 129. 1846; Gray, Proc. Am. Acad. **10:** 61. 1875; Benth. & Hook. Gen. Pl. **2:** 850. 1876; Gray, Syn. Fl. N. Am. **2**[1]**:** 196–197. 1878.

Krynitzkia, section *Pterygium* Gray, Proc. Am. Acad. **20:** 276. 1885, in part.

Krynitzkia, section *Pseudokrynitzkia* Gray, Proc. Am. Acad. **20:** 276–280. 1885, in large part; Coulter, Manual Rocky Mt. Region, 164. 1885.

Oreocarya Greene, Pittonia **1:** 57–58. 1887; *Ibid.* **3:** 109–115. 1896; Gürke in Engl. & Prantl, Nat. Pflanzenfam. IV. Abt. 3a & 3b. 109. 1897; A. Nelson, Erythea **7:** 65–68. 1899; Howell, Fl. Nw. Am. 486. 1900; Eastwood, Bull. Torr. Bot. Club **30:** 238–246. 1903; Britton, Manual, ed. 2, 770. 1905; Piper, Contr. U. S. Nat. Herb. **11:** 481–482. 1906; Rydb. Fl. Colo. 287–288. 1906; A. Nelson in Coulter & Nelson, Man. Cent. Rocky Mts. 416–419. 1909; Britton & Brown, Ill. Fl., ed. 2, **3:** 80. 1913; Wooton & Standley, Contr. U. S. Nat. Herb. **19:** 544–546. 1915; Macbride, Contr. Gray Herb. **48:** 20–38. 1916; Rydb. Fl. Rocky Mts. 719–725. 1917; Tidestrom, Contr. U. S. Nat. Herb. **25:** 457–460. 1925; Payson, Univ. Wyo. Publ. Bot. **1:** 164–171. 1926.

Perennial or biennial herbs with a conspicuous setose, hirsute or sericeous indument (except in *C. pustulosa*). Leaves entire, oblanceolate, spatulate or linear. Stems solitary from the root or caespitose, commonly unbranched below the inflorescence, 0.5–9 dm. high. Inflorescence a continuous or glomerate cluster of elongating or reduced, simple or branched, bracteate or nearly ebracteate, two-ranked, unilateral, scorpioid cymes. Sepals distinct, usually conspicuously accrescent. Corollas white or yellow, salverform; limb 4–12 mm. broad; tube equalling or ex-

ceeding the sepals. Stamens included in the tube, anthers sessile or nearly so. Style equalling or much exceeding the mature nutlets; stigma entire. Nutlets from nearly circular in outline to narrowly lanceolate, margined or winged, smooth or variously roughened on the different surfaces, attached to the gynobase at a point $^1/_3$–$^4/_5$ of the distance from the base to the apex of the nutlet. Scar of nutlets various, open or closed and margin elevated or plane. Generic type: *C. Bradburiana* Payson.

ARTIFICIAL KEY TO THE SPECIES OF CRYPTANTHA, SECTION OREOCARYA

a. Tube of the corolla distinctly longer than the calyx lobes in anthesis.
  b. Nutlets smooth on the dorsal and ventral surfaces; leaves linear-oblanceolate, usually acute, densely appressed-strigose, petioles ciliate.
    c. Corollas yellow, individuals distinctly dimorphic as regards stamen insertion; species ranging from central Wyoming south and west to southern California.
      d. Nutlets broadly ovate in outline, distinctly wing-margined, all four usually maturing; inflorescence distinctly glomerate; native from Utah to southern California.....*5. C. confertiflora*
      dd. Nutlets lanceolate in outline, scarcely wing-margined, some usually aborting; inflorescence scarcely glomerate; native from central Wyoming through western Colorado to northern New Mexico and eastern Utah.....*6. C. flava*
    cc. Flowers white; individuals less evidently dimorphic as regards stamen insertion; native to Washington and (?) Oregon.....*7. C. leucophaea*
  bb. Nutlets more or less roughened or wrinkled on dorsal surfaces; leaves various.
    c. Nutlets uniformly muricate or papillose, not evidently tuberculate, rugose or wrinkled.
      d. Leaves silky-strigose, pustulate hairs small or lacking; fornices elongated.
        e. Muriculations usually acute and sometimes minutely setose; eastern Utah, adjacent Colorado to northern New Mexico and northeastern Arizona.....*36. C. fulvocanescens*
        ee. Muriculations conspicuously setose, sometimes almost arborescent; southern and southwestern Utah and adjacent Arizona. .....*37. C. echinoides*
      dd. Leaves appressed-setose and coarsely strigose, conspicuously pustulate on both leaf surfaces; fornices low and rounded. .....*38. C. Jonesiana*
    cc. Nutlets more or less rugose or tuberculate, sometimes conspicuously muricate also.
      d. Inner or ventral surfaces of the nutlets smooth or nearly so; margin evidently but rather narrowly wing-margined.....*4. C. oblata*

dd. Inner surfaces of the nutlets distinctly roughened.
e. Nutlets conspicuously muricate, some of these confluent into rugae; scar narrow, straight, open, no indication of an elevated margin.....*38. C. Jonesiana*
ee. Nutlets rugose or tuberculate, these more conspicuous than the murications; scar various, margin distinctly elevated in some species.
f. Margins of the nutlets not in contact, fruit oblate-ovoid; densely caespitose perennials; pustulate hairs lacking on upper leaf surfaces.....*43. C. paradoxa*
ff. Margins of the nutlets in contact.
g. Scar of the nutlets conspicuously open and surrounded by a definite elevated margin.....*46. C. flavoculata*
gg. Scar of the nutlets closed or slightly open but then not surrounded by a definitely limited and conspicuous elevated margin.
h. Leaves sparsely if at all pustulate ventrally, even in age.
i. Scar of the nutlets surrounded by an elevated margin but tightly closed, leaves oblanceolate or broader.*44. C. Bakeri*
ii. Scar neither tightly closed nor surrounded by an evident elevated margin.
j. Leaves narrowly linear-spatulate, nutlets sharply and deeply rugose.....*41. C. tenuis*
jj. Leaves obovate or broadly oblanceolate; nutlets with rounded rugae and tubercles; fornices long-papillose.....*39. C. Wetherillii*
hh. Leaves conspicuously pustulate ventrally, especially in age; corolla tube 1 cm. or more long; Colorado..*40. C. longiflora*
aa. Tube of the corolla equalling or shorter than the calyx lobes in anthesis.
b. Nutlets smooth on the dorsal surfaces, not rugose, muricate or tuberculate.
c. Fruit depressed, globular, nutlets not in contact by their margins.
d. Leaves conspicuously pubescent on both surfaces.
e. Crests at base of corolla tube conspicuous; calyx not conspicuously accrescent.....*1. C. Jamesii*
ee. Crests at base of corolla tube obsolete; calyx conspicuously accrescent.....*3. C. Palmeri*
dd. Leaves glabrous above, sparingly hairy below.....*2. C. pustulosa*
cc. Fruit conical or ovoid, nutlets in contact by their margins.
d. Stout, strictly erect plants with many elongated and conspicuous bracts in the inflorescence; eastern Colorado and southeastern Wyoming.....*13. C. virgata*
dd. Smaller, somewhat caespitose plants with few or inconspicuous bracts in the inflorescence; central Idaho.....*8. C. salmonensis*
bb. Nutlets more or less roughened (muricate, wrinkled, tuberculate), at least on the dorsal surfaces.
c. Nutlets densely and uniformly muricate, not rugose or tuberculate.
d. Pubescence of leaves silky-strigose or strigillose but not subtomentose.

e. Leaves nearly or quite uniformly silky-strigose.
f. Plants scarcely or only moderately caespitose; leaves broadly oblanceolate or spatulate; native to northeastern Utah and adjacent Colorado (?) ..... *35. C. breviflora*
ff. Plants densely caespitose, caudex multicipital; leaves linear-oblanceolate; native to eastern Wyoming and adjacent Nebraska and Colorado ..... *33. C. cana*
ee. Leaves with two distinctly different kinds of trichomes .... *32. C. nana*
dd. Leaves distinctly subtomentose as well as appressed-setose .. *32. C. nana*
cc. Nutlets not exclusively muricate.
d. Inner surfaces of the mature nutlets smooth or nearly so, not conspicuously rugose, tuberculate or muricate.
e. Nutlets ovate, papery with a broad, thin wing-margin; stout, erect plants 2.5–8 dm. tall; native to Utah and Arizona ..... *12. C. setosissima*
ee. Nutlets ovate to lanceolate, not with a broad, thin wing-margin if the nutlets are ovate in outline.
f. Stout, strictly erect plants with many elongated and conspicuous foliar bracts in the spiciform inflorescence .... *13. C. virgata*
ff. Lower, more slender plants; inflorescence not spiciform nor with numerous elongated foliar bracts that greatly exceed the flowers.
g. Inflorescence very broad and rounded in outline; nutlets not wing-margined; native to the eastern slope of the continental divide from Wyoming to central New Mexico ..... *20. C. thyrsiflora*
gg. Inflorescence narrower; nutlets usually with an evident wing-margin (except in *C. rugulosa*); native west of the continental divide.
h. Nutlets with evident transverse rugae, these more conspicuous than the tubercles that may be present.
i. Nutlets scarcely or not at all muricate between the rugae.
j. Strictly erect, conspicuously setose perennial of Colorado ..... *9. C. stricta*
jj. Caespitose, less conspicuously setose perennials of high elevation in Idaho, Nevada, Oregon, and California. ..... *10. C. nubigena*
ii. Nutlets distinctly muricate between the rugae and near the margins of the nutlets.
j. Erect perennials from western Utah ..... *24. C. rugulosa*
jj. Caespitose and more or less soboliferous perennials from Montana ..... *30. C. sobolifera*
hh. Nutlets with distant tubercles and no conspicuous rugae; native of the southern Sierra Nevada ..... *11. C. Clemensae*
dd. Inner surfaces of the nutlets conspicuously and definitely rugose, tuberculate or muricate.
e. Scar of the nutlets evidently open some distance above the base.
f. Scar somewhat constricted some distance below the middle of the open portion.

g. Elevated margin of the scar definitely limited; pustules present on both leaf-surfaces.....*45. C. mensana*
gg. Elevated margin indefinitely limited; pustules present only on the lower surface of the leaves.....*42. C. Osterhoutii*
ff. Scar triangular and not constricted below the middle.
g. Some tendency to elevated margin evident around the scar.
h. Cymules elongating and so the inflorescence broad; biennial or short-lived perennials; nutlets with an evident dorsal ridge.
i. Surfaces of the leaves conspicuously setose with spreading bristles; inflorescence crowded.....*15. C. virginensis*
ii. Surfaces of the leaves with inconspicuous appressed bristles; inflorescence open.....*14. C. insolita*
hh. Cymules shorter and inflorescence narrow; long-lived perennials; nutlets with only a slight dorsal ridge, if any.
i. Nutlets indefinitely tuberculate and rugose; California .....*16. C. tumulosa*
ii. Nutlets definitely tuberculate or rugose; Utah and eastern Nevada.....*17. C. modesta*
gg. No tendency to an elevated margin around the scar.
h. Style exceeding the mature nutlets by 1 mm. or more.
i. Leaves finely strigose and appressed-setulose; densely caespitose perennials of eastern Oregon and adjacent Idaho.....*34. C. propria*
ii. Leaves setose and tomentose, less densely caespitose. .....*18. C. humilis*
hh. Style not exceeding the mature nutlets by more than 0.5 mm.; densely caespitose perennials of southern Wyoming. .....*19. C. caespitosa*
ee. Scar of the nutlets closed or nearly so, no conspicuous triangular, open area near the base.
f. Upper surface of the leaves uniformly appressed-strigose and without pustules.
g. Nutlets sharply rugose and tuberculate; scar surrounded by an elevated margin.....*44. C. Bakeri*
gg. Nutlets not so sharply rugose or tuberculate; scar not surrounded by an elevated margin.
h. Densely caespitose from a multicipital caudex; native to eastern Oregon and western Idaho.....*34. C. propria*
hh. Less evidently or not at all caespitose; native to Utah, Colorado, and Wyoming.....*22. C. sericea*
ff. Upper surface of the leaves with two distinct kinds of hairs, pustulate.
g. Densely caespitose perennials; style not over 0.5 mm. longer than mature nutlets; stems not over 1.5 dm. high. .....*19. C. caespitosa*
gg. Caespitose or solitary plants; stems usually more than 1.5 dm. high.
h. Perennials; mostly native in the Rocky Mountains or west of them.

i. Mature sepals exceeding the nutlets by 2–3 mm.; inflorescence broad-topped; western Colorado.....*21. C. elata*
ii. Mature sepals exceeding the nutlets by 4–8 mm.
j. Nutlets tuberculate, scarcely if at all rugose.
k. Ventral surfaces of the nutlets nearly smooth; Montana.....*30. C. sobolifera*
kk. Ventral surfaces of the nutlets distinctly roughened.
l. Stems 1–2 dm. high; inflorescence spreading; western Colorado.....*23. C. aperta*
ll. Stems 2–9 dm. high; inflorescence usually narrower; Nevada to Montana.
m. Nutlets broadly lanceolate; muricications lacking or indefinite; Oregon, Washington, and Montana.....*28. C. Sheldonii*
mm. Nutlets narrowly lanceolate; muricications very definite.....*25. C. interrupta*
jj. Nutlets more or less rugose.
k. Scar of the nutlets somewhat open at the base; Nevada and California.....*18. C. humilis*
kk. Scar closed or very nearly so; northerly in range.
l. Nutlets 4–5 mm. long; along the Columbia River and tributary streams in Oregon and Washington.....*27. C. celosioides*
ll. Nutlets less than 4 mm. long.
m. Leaves narrowly oblanceolate, strongly hirsute-ciliate.
n. Stems slender; nutlets 3–4 mm. long; Idaho and Washington.....*26. C. spiculifera*
nn. Stems slender; nutlets 2–3 mm. long; Canada, Washington, Wyoming..*29. C. Macounii*
mm. Leaves broadly oblanceolate or spatulate.
n. Ventral surfaces of the nutlets nearly smooth; Montana.....*30. C. sobolifera*
nn. Ventral surfaces of the nutlets distinctly rough; Oregon to Montana.....*28. C. Sheldonii*
hh. Biennials; native to the plains east of the Rocky Mountains and to the foothill region east of the continental divide.....*31. C. Bradburiana*

Series 1. JAMESIANAE. Nutlets smooth on all surfaces, or rugose or tuberculate but not at all muricate on the dorsal surface, ventral surfaces quite or nearly smooth. Nutlets often wing-margined. Scar narrow, straight and closed or nearly so. Margins not elevated. Species 1–11.

1. C. Jamesii (Torr.) new comb.

Myosotis suffruticosa Torr. Ann. Lyc. N. Y. **2**: 225. 1827, not *Cryptantha suffruticosa* Piper, Proc. Biol. Soc. Wash. **32**: 42. 1919.

Perennial; leaves linear-oblanceolate, obtuse or acute, 3–15 cm. long, indument usually appressed, scarcely hispid (in some forms conspicuously setose), pustules small, sometimes confined to the dorsal surface, always more numerous dorsally than ventrally; inflorescence usually open, cymes elongating, setose-hirsute and subtomentose; sepals lanceolate, acute, in anthesis 3–4 mm. long, in fruit 5–6.5 mm. long, exceeding the nutlets by 3–4 mm.; corolla white, tube 2.5–3 mm. long, usually distinctly shorter than the sepals, crests at the base of the tube conspicuous and well developed, fornices probably yellow, elongated, usually emarginate, about 1 mm. long, slightly papillose, limb 6–8 mm. broad, tube and limb subequal, lobes united for $^1/_5$ to $^1/_4$ their length; fruit strongly oblate-ovoid, 1–4 nutlets maturing, style exceeding the nutlets by 1–2 mm.; nutlets rather narrowly ovate-lanceolate in dorsal outline, 2–2.5 mm. long, acute, with margins widely separated, acute, surfaces of nutlets smooth, glossy (with 30 diameters magnification the surfaces are evidently puberulent), scar tightly closed, extending from the base to near the apex, no elevated margin.

Distribution: Upper Sonoran and Transition Zones of the southern Rocky Mountain region from central Wyoming to Chihuahua and from western South Dakota and Texas to Nevada and southern California.

The varieties of *C. Jamesii* are contrasted as follows:

Stems branched from the base, simple above, erect, 2–4.5 dm. tall; leaves tufted at the base; from southern Colorado and Utah to northern Mexico. ..... *1a.* var. *multicaulis*

Stems branched from near the base and upwards, erect, 2.5–4 dm. tall; leaves apparently not tufted at the base, linear or nearly so; cymes usually much elongated; northern Mexico and western Texas ..... *1b.* var. *laxa*

Stems branched from the base, simple or sparingly branched above, erect, 1.2–2.5 dm. high; leaves somewhat tufted at the base; southern Colorado and Utah to northern New Mexico and Arizona ..... *1c.* var. *cinerea*

Stems rather sparingly branched from the base and upwards, erect, 2.5–3.5 dm. high; leaves green, sparsely strigose on both surfaces, conspicuously pustulate below, sparsely so above; southeastern Utah and northeastern Arizona ..... *1d.* var. *disticha*

Stems branched upwards as well as from the base, more or less decumbent, 1–3 dm. long; leaves usually not tufted at the base; western Dakota and eastern Wyoming to eastern Colorado ..... *1e.* var. *typica*

Stems branched from the base, usually simple upwards, prostrate or nearly so, 0.6–1.5 dm. long; leaves somewhat tufted at the base; eastern deserts of southern California and adjacent Nevada ..... *1f.* var. *abortiva*

1a. Var. **multicaulis** (Torr.) new comb. Plate 25, figs. 1–4.

Eritrichium multicaule Torr. in Marcy, Expl. Red River, 262. 1854.

Oreocarya multicaulis (Torr.) Greene, Pittonia **3:** 114. 1896.

Krynitzkia multicaulis var. *setosa* Jones, Contr. West. Bot. **13:** 4. 1910. (Type: "near Ft. Cove, Utah, June 27, 1901, growing under junipers." *M. E. Jones.*)

Oreocarya suffruticosa var. *multicaulis* (Torr.) Payson, Univ. Wyo. Publ. Bot. **1:** 171. 1926.

Perennial from a woody root; stems branched from the base, simple above, erect, rather slender, 20–45 cm. tall, strigose and pilose-hirsute; leaves tufted at the base, 5–15 cm. long, dorsal surface strigose, appressed-setulose (in occasional forms setose-hirsute), pustulate, ventral surface uniformly strigose, rarely sparsely pustulate, petioles long-hairy toward the base, finely ciliate; inflorescence becoming open by the elongation of the cymes, usually confined to the upper ¼, or less, of the stem, foliar bracts inconspicuous; 2–4 nutlets commonly maturing.

Distribution: Upper and Lower Sonoran Zones, northwestern Oklahoma, western Texas, southwestern Colorado, New Mexico, southern Utah, eastern Nevada, Arizona and northern Mexico. Type: from near Santa Fe, New Mexico, *Fendler 636.*

Specimens examined:

Oklahoma: near Knowles, Beaver Co., May 5, 1913, *Stevens 335* (Mo., Gray); near Shattuck, Ellis Co., May 10, 1914, *Clifton 3039* (Mo.); near Shattuck, May 16 and 17, 1914, *Stevens 3039, 3024* (Gray).

Texas: sandhills on Canadian, Hemphill Co., June 4, 1901, *Eggert* (Mo.); Big Springs, May 15, 1902, *Tracy 7835* (Minn., U. S.); Dalhart, June 24, 1920, *Jones 339* (Gray); Ft. Davis, June, 1881, *Havard* (U. S.); Clarendon, 1888, *Nealley* (U.S.).

Colorado: Durango, July 10, 1896, *Tweedy 576* (U.S.); Arboles. June, 1899, *Baker 563* (Pomona, R. Mt., Mo., U.S., Gray).

New Mexico: Tunitcha Mts., Aug. 8, 1911, *Standley 7830* (U.S.); near Cedar Hill, San Juan Co., Aug. 16, 1911, *Standley 7967* (U.S.); near Farmington, San Juan Co., July 20, 1911, *Standley 7125* (U.S.); near Santa Fe, 1847, *Fendler 636* (N.Y., U.S., Gray); near Las Vegas, June, 1920, *Anect 164* (U.S.);

Albuquerque, Sept. 21, 1884, *Jones 6687* (Pomona); near Pecos, San Miguel Co., Aug. 15, 1908, *Standley 4899* (U.S., Mo.); Florita Mts., Sept. 7, 1903, *Jones* (Pomona); Las Palomas, Sandia Mts., April–May, 1914, *Ellis 366* (Mo., U.S.); Balsam Park, Sandia Mts., Aug. 4, 1914, *Ellis 463* (U.S.); Datil, Socorro Co., Sept. 29–Oct. 1, 1919, *Eggleston 16184* (Field); near Roswell, June, 1914, *Wooton* (U.S.); Doña Ana, April, 1851, *Thurber 293* (Gray); Jornada del Muerto, April, 1851, *Thurber 278* (Gray); Organ Mts., Aug. 28, 1897, *Wooton 401* (Pomona, R. Mt., Calif., Minn., Mo., U.S.); Organ Mts., July 15, 1897, *Wooton 595* (Minn., Mo., U.S.); Animas Valley, Oct. 2, 1893, *Mearns 2522* (U.S.); Carrizallito Mts., April 17, 1892, *Mearns 111* (U.S.); Silver City, April 28, 1919, *Eastwood 8366* (U.S., Gray); Middle Fork of the Gila, Mogollon Mts., Aug. 5, 1900, *Wooton* (U.S.); north of Carrizozo, Aug. 28, 1904, *Wooton 2818* (U.S.); Mangas Springs, n.w. of Silver City, May 17, 1903, *Metcalfe 70* (Pomona, R. Mt., Calif., Minn., U.S., Gray); Mogollon Mts., Aug. 9, 1903, *Metcalfe 431* (Pomona, Minn., U.S., Calif., Gray); Gila Hot Springs, Mogollon Mts., Aug. 27, 1903, *Metcalfe 863* (R. Mt., Mo.); Mimbres River, Grant Co., July 1, 1904, *Metcalfe 1061* (U.S.); Santa Rita del Cobre, 1877, *Greene 32* (Gray).

Utah: Pahria Canyon, May 26, 1894, *Jones 5297q, 5298b* (U.S.); canyon above Tropic May, 28, 1894, *Jones 5300* (Pomona, U.S.).

Arizona: Fort Valley, Coconino Nat'l. Forest, July 14, 1909, *Pearson 210* (U.S.); Metcalfe, Oct. 1, 1900, *Davidson 608* (Gray); Ft. Apache, June 21–30, 1890, *Palmer 591* (U.S., in part); Skull Valley, April 28, 1903, *Jones* (Pomona); Flagstaff, Aug. 6, 1884, *Jones 4007* (Pomona, R. Mt., U.S.); Flagstaff, June 4, 1898, *MacDougal 49* (R.Mt., Calif., U.S., Gray); near Flagstaff, June 17, 1901, *Leiberg 5545* (U.S.); Flagstaff, Aug. 25, 1883, *Rusby 749* (Calif., U.S.); northeast of Flagstaff, June 8, 1922, *Hanson A140* (Mo.); San Francisco Mts., Aug. 3, 1923, *Jaeger* (Pomona); San Francisco Mts., April, 1881, *Rusby 283* (Minn., U.S.); San Francisco Mts., Oct. 1881, *Lemmon & wife* (R. Mt.); Williams, Aug. 6–15, 1903, *Griffiths 4912* (U.S.); Bowie, Sept. 18, 1884, *Jones 6685* (Pomona); Cosnino, Aug. 9, 1884, *Jones 4047* (Pomona, U.S.); Santa Rita Forest Reserve, March 31–April 23,

1903, *Griffiths 4268* (U.S.); Alpine, July 31, 1912, *Goodding 1264* (R. Mt., Calif., U.S.); Outlaw Canyon, Chiricahua Mts., July 30, 1907, *Goodding 2349* (R.Mt., Gray).

Nevada: Ely, June 26, 1907, *Jones* (Pomona).

Chihuahua: Mexican boundary near White Water, June 18, 1892, *Mearns 359, 360* (U.S.); base of San Luis Mts., Sept. 5, 1893, *Mearns 2091* (U.S.); Casas Grandes, May 13, 1899, *Goldman 407* (U.S., Gray); plains of Guerrero, Sept. 8, 1887, *Pringle* (Calif.).

1b. Var. **laxa** (Macbr.) new comb.

Oreocarya multicaulis var. *laxa* Macbr. Contr. Gray Herb. **48:** 35. 1916.

Perennial; stems branched from near the base and upwards, erect, rather stout, 2.5–4 dm. high, strigose and hirsute with ascending hairs; leaves numerous, linear or linear-oblanceolate, acute, 6–12 cm. long, rather coarsely and sparsely appressed-strigose below, finely strigose above, pustulate on both surfaces but much more abundantly so on lower; inflorescence broad and open, the cymes becoming much elongated in age (10 cm.), confined to the upper ¼–½ of the stem, foliar bracts not conspicuous, linear.

Distribution: Lower Sonoran Zone in northern Chihuahua, Mexico, and western Texas. Type: sand hills near Paso del Norte, Chihuahua, *C. G. Pringle 776.*

Specimens examined:

Texas: Marfa, Sept. 1883, *Havard* (U.S.).

Chihuahua: sand hills near Paso del Norte, Sept. 20, 1886, *Pringle 776* (Field, Mo., Phila., U.S., Gray, TYPE); between Casas Grandes and Sabinal, Sept. 4–5, 1889, *Nelson 6350* (U.S., Gray).

1c. Var. **cinerea** (Greene) new comb.

Oreocarya cinerea Greene, Pittonia **3:** 113. 1896.

O. Lemmoni Eastw. Bull. Torr. Bot. Club **30:** 239. 1903. (Type: Arizona, without definite locality, 1884, *Lemmon.*)

O. multicaulis var. *cinerea* (Greene) Macbr. Proc. Am. Acad. **51:** 54. 1916.

O. suffruticosa var. *cinerea* (Greene) Payson, Univ. Wyo. Publ. Bot. **1:** 171. 1926.

Perennial; stems branched from the base, simple or sparingly branched above, erect, rather slender, 12–25 cm. high, strigose and setose-hirsute; leaves somewhat tufted at the base, 5–15 cm. long, dorsal surface strigose and appressed-setulose (rarely setose-hirsute), pustulate, ventral surface densely and uniformly strigose, with few or no pustules, petioles long-hairy at the base, finely ciliate; inflorescence becoming open by the elongation of the cymes, usually confined to the upper ⅓ or ⅔ of the stem, bracts of the lower part of the inflorescence rather large and leaf-like; 2–4 nutlets commonly maturing.

Distribution: Upper Sonoran and Transition Zones of south central Colorado, northern New Mexico, southern Utah, northern Arizona and eastern Nevada. Type: "Confined, as far as I know, to the Arkansas Valley, in southern Colorado, where it occupies low subsaline clayey soils," *Greene*.

Specimens examined:

Colorado: Canyon City, June 28, 1917, *Payson 1019* (R.Mt.); Canyon City, June 27, 1895, *Osterhout 628* (R.Mt., Minn., Osterh.); Rocky Ford, June 18, 1900, *Osterhout 2087* (R.Mt., Osterh.); Florence, June 14, 1892, *Cowen* (Mo.); Wet Mountain Valley, June 20, 1873, *Brandegee* (Mo.); plains, Pueblo, 1873, *Greene* (Gray); Pueblo, June, 1890, *Mr. & Mrs. G. H. Hicks 178* (Minn.); mesas near Pueblo, May 14, 1900, *Rydberg & Vreeland 5702* (R.Mt.); Buena Vista, July 6, 1892, *Sheldon 527* (U.S.); Gunnison, July 29, 1925, *Smith 7680* (R.Mt.); Gunnison, July 17, 1901, *Baker 455* (Pomona, R.Mt., Minn., Mo., U.S., Gray).

New Mexico: 15 miles w. of Sante Fe, May 22, 1897, *A. A. & E. G. Heller 3577* (Pomona, Minn., Mo., U.S., Gray).

Utah: along Bullion Creek, above Marysvale, July 21, 1905, *Rydberg & Carlton 7041* (R.Mt., U.S.); Marysvale, May 31, 1894, *Jones 5328* (Pomona, Calif., Mo., U.S.); near Fort Cove, June 27, 1901, *Jones* (Pomona).

Arizona: Moki Indian Reservation, Aug. 1–Sept. 5, 1897, *Hough 8* (U.S.); Grand Canyon, June, 1915, *Macbride & Payson 950* (R.Mt., U.S., Gray); vicinity of Flagstaff, July 2, 1898, *MacDougal 204* (R.Mt., Calif., Phila., U.S., Gray); Cosnino, Aug. 9, 1884, *Jones 4042* (Pomona, R.Mt., U.S.); near Flagstaff, May–Oct., 1901, *Purpus 8195* (Calif., Mo.); Cosnino, June 9, 1890,

Jones (Pomona); San Francisco Mts., June 9, 1893, *Jones 6688* (Pomona); San Francisco Mts., May–Oct., 1900, *Purpus 8048a, 7067* (Calif.); Ash Fork, June 18, 1901, *Barber 112* (U.S.); Prescott, 1876, *Palmer 375* (Gray); Peach Springs, May 26, 1884, *Jones 6684* (Pomona, R.Mt., Calif.).

Nevada: Ely, Aug. 11, 1913, *Hitchcock 1193* (U.S.); Mt. Magruder, May–Oct., 1898, *Purpus 6068* (Pomona, U. S.).

1d. Var. **disticha** (Eastw.) new comb.

Oreocarya disticha Eastw. Bull. Torr. Bot. Club **30:** 238. 1903.

Perennial; stems branched from the base and more or less branched upwards, strigose and sparingly setose with slender ascending trichomes, 2.5–3.5 dm. high, erect; leaves narrowly oblanceolate, obtuse or acute, 5–8 cm. long, green, sparsely strigose on both surfaces, densely pustulate beneath, sparingly so above; inflorescence open, cymes elongating, lax, foliar bracts rather conspicuous; 1–4 nutlets maturing.

Distribution: Upper Sonoran and Transition Zones in southeastern Utah and northeastern Arizona. Type: "on the mesa above the San Juan River, Utah, on what was known as Barton's Range, July 13, 1895," *Eastwood.*

Specimens examined:

Utah: Rabbit Valley, Aug. 12, 1875, *Ward 557* (U.S., Mo.); Thousand Lake Mt., July 14, 1875, *Ward 393* (U.S.); Barton Range, s.e. Utah, July 13, 1895, *Eastwood* (Calif., U.S., Mo., Gray).

Arizona: Laguna Canyon, July 10–11, 1920, *Clute 37* (U.S., R.Mt., Gray).

1e. Var. **typica** n. var.

Myosotis suffruticosa Torr. Ann. Lyc. N. Y. **2:** 225. 1827.

Eritrichium Jamesii Torr. in Marcy, Expl. Red River, 262. 1854.

Krynitzkia Jamesii (Torr.) Gray, Proc. Am. Acad. **20:** 278. 1885, in part.

Oreocarya suffruticosa (Torr.) Greene, Pittonia **1:** 57. 1887.

Perennial, but probably shorter-lived than in the varieties *cinerea* and *multicaulis;* stems branched upwards as well as from

the base, more or less decumbent, 10–30 cm. long, rather slender, strigose and setose-hirsute; leaves usually not tufted at the base, linear-oblanceolate, 3–8 cm. long, dorsal surface densely strigose and appressed-setulose, pustulate, ventral surface uniformly strigose, only rarely appressed-setulose or pustulate, petioles somewhat ciliate near the base; inflorescence open, mostly confined to the upper ⅓–⅔ of the stem, cymes elongating, bracts of the lower part of the inflorescence elongated and leaf-like; 2–4 nutlets commonly maturing.

Distribution: Upper Sonoran Zone in the western part of South Dakota, Nebraska, and Kansas, northwestern Oklahoma and Texas, southeastern Wyoming, and eastern Colorado. Type: "barren desert along the Platte," *James*.

Specimens examined:

South Dakota: Indian Creek, Aug. 26, 1891, *Williams* (Wash.).

Nebraska: Alliance, June 29, 1913, *Bates 5768* (Minn.); Alliance, May 16, 1914, *Bates 5897* (Minn.); near Plummer Ford, Thomas Co., July 8, 1893, *Rydberg 1514* (N.Y., U.S., Gray); Wild Cat Mts., Banner Co., July 16, 1891, *Rydberg 254* (U.S.); Sidney, May 23, 1922, *Nelson* (R.Mt.).

Kansas: near Hay Springs, June 6–7, 1901, *MacDougal 79* (N. Y., Mont.); Hamilton Co., Aug. 3, 1895, *Hitchcock 347* (R. Mt., U.S., Gray); Syracuse, Hamilton Co., July 11, 1893, *Thompson 97* (N.Y., U.S.); Comanche Co., June 17, 1891, *Carlton 246* (U.S.); Arkalon, Seward Co., June 27, 1888, *Kellerman 6* (U.S.).

Texas: Canadian, July 8, 1912, *Condit* (Calif.).

Wyoming: Casper, July 6, 1901, *Goodding 208* (R.Mt., Pomona, Mo., U.S., Gray); Platte River at Ferris, July 19, 1898, *E. Nelson 4906* (R.Mt., Mo., U.S., Gray); Douglas, July 20, 1915, *Hess 106* (R.Mt.); Uva, July 31, 1896, *Nelson 2567* (R.Mt., Minn.); Platte River Canyon (Wheatland), July 14, 1894, *Nelson 477* (R.Mt., Wash., Minn., Mo., U.S., Gray); Powder River, June 28, 1910, *Nelson 9379* (R.Mt., Minn., Gray); Ft. Laramie, June 29, 1901, *Nelson 8305* (R.Mt.); Pine Bluffs, June 28, 1889, *Bodin* (Minn.); Pine Bluffs, May 15, 1897, *Nelson 2882* (R.Mt.).

Colorado: Wray, July 14, 1909, *Osterhout 3992* (R.Mt., Osterh.); Wray, July 1–4, 1919, *Eggleston 15168* (Pomona); Sterling, Logan Co., June 12, 1896, *Osterhout* (Minn.); Ft. Lupton, July 8, 1916,

Johnston 845 (Mo., U.S.); White Rocks, Boulder Co., July 19, 1918, *Cockerell* (U.S.); near Boulder, July, 1902, *Tweedy 5219* (R.Mt.); barren deserts high up on the Platte, *James* (N.Y., TYPE); Denver, July 10, 1919, *Payson & Bethel 1608* (R.Mt.); North Denver, Aug. 12, 1910, *Eastwood* (Gray); Golden, June 3, 1870, *Greene 300* (Gray); Castle Rock, June 30, 1917, *Payson 1027* (R.Mt.); Table Rock, El Paso Co., July 15, 1891, *Crandall* (Calif.); Colorado Springs, June 26, 1903, *Shantz 571* (U.S.); Colorado Springs, July 3, 1895, *Osterhout 627* (R.Mt., Osterh.); Colorado Springs, July 22, 1920, *Johnston 2809* (Gray); Colorado Springs, June 19–30, 1915, *Eggleston 11194a* (U.S.); Colorado Springs, May 28, 1879, *Jones* (Pomona); Colorado Springs, May 15, 1878, *Jones 66* (U.S.); Salida, Aug. 2, 1925, *Smith 3912* (R. Mt.); Blanca, Costilla Co., June 27, 1921, *Bethel, Nielley & Clokey 4258* (R.Mt., Phila.).

1f. Var. **abortiva** (Greene) new comb.

Oreocarya abortiva Greene, Pittonia **3:** 114. 1896.

Krynitzkia multicaulis var. *abortiva* (Greene) Jones, Contr. West. Bot. **13:** 5. 1910.

Oreocarya suffruticosa var. *abortiva* (Greene) Macbr. Proc. Am. Acad. **51:** 547. 1916.

Perennial from a woody root; stems branched from the base, usually simple upwards, rather slender, prostrate or nearly so, 6–15 cm. long, strigose and hirsute; leaves somewhat tufted at the base, 5–10 cm. long, dorsal surface densely strigose, appressed-setose and pustulate, petioles long-hairy at the base, finely ciliate; inflorescence not raised above the leaves, extending over ¾ of the stem, bracts conspicuous and elongated; 2–3 nutlets frequently aborted.

Distribution: Upper Sonoran Zone in the eastern deserts of southern California and in southern Nevada. Type: "Bear Valley, San Bernardino Mountains, California," *S. B. Parish.*

Specimens examined:

Nevada: Lee Canyon, Charleston Mts., Clark Co., July 28, 1913, *Heller 11016* (Calif., Phila., Field, U.S., Gray).

California: north side of Bear Valley, June 12, 1922, *Munz 5721* (Pomona, Calif., Gray); east of Big Meadows, San Bernardino

Mts., June 21, 1922, *Pierson 3103* (Pomona); Bear Valley, San Bernardino Co., July 19, 1900, *Jones 5315f* (Pomona); Bear Valley, June 16–20, 1895, *Parish 3694* (Calif., Gray); Bear Valley, May, 1882, *Parish 1480* (Calif., Mo., U.S., Gray); Bear Valley, 6500 ft., June 15, 1894, *Parish 3238* (U.S.).

C. Jamesii, in the aggregate sense, is the most widely distributed and most heterogeneous species in the genus. As a species it is very easily recognized by the smooth nutlets that are not in contact by their edges. It is likely to be confused with only two other units that are here accorded specific rank, *C. pustulosa* and *C. Palmeri*. The glabrous stems and ventral leaf surfaces distinguish the former, and the accrescent calyces, longer corolla tubes, and lack of crests at the bases of the tubes identify the latter.

The varieties of *C. Jamesii* are quite difficult of determination, and intermediates between the various groups are of fairly common occurrence. These intermediates are usually in intermediate ranges but occasionally occur far inside the range of a different variety. It is possible, of course, that some of these anomalies are produced by unusual habitats. This is the more probable since the differences between the varieties are entirely those of habit. Since the different forms are fairly well segregated geographically it is to be expected that local floras will continue to treat the variants as separate species. This is greatly to be deplored, since it will overemphasize the distinctions and serve to make determinations difficult.

On the other hand, the general consistency of the varietal ranges makes it certain that the varieties are really incipient species and so worthy of named recognition in any critical work. The author has no doubt but that some specimens cited are incorrectly placed. Sometimes in examining two duplicates of the same collection one is tempted to place one in one variety and the other in a different one. Botanists working in an intermediate range, such as at Flagstaff, Arizona, will probably find the varieties, as in this case, *cinerea* and *multicaulis*, in hopeless confusion.

The setose-hispid form of the variety *multicaulis* is, according to Macbride, to be considered as typical *multicaulis*. He would make the matter of spreading or appressed pubescence the cri-

terion of distinction between *cinerea* and *multicaulis*. It seems to the present author that such a classification cuts across the lines of real relationship. *Cinerea* is more than a form of *multicaulis* with appressed setae. There are more specimens of *multicaulis* with appressed than with spreading setae. *Cinerea* is a growth form intermediate between *multicaulis* and *typica* and as such is perhaps the least definite of the varieties. It might be better to submerge the variety *cinerea* in *multicaulis*. It is on the southern edge of the range of *cinerea* that it is most difficult of delimitation. The var. *setosa* Jones is an exact synonym of Macbride's idea of *multicaulis*.

The variety *laxa* seems certainly more than the ecological variety that Macbride suggested. Other collections of it have confirmed its peculiarities.

The variety *disticha* needs much more study, but the similar collections from the type region seem to assure the general prevalence of an unusually green form of the species in southern and southeastern Utah and adjacent Arizona. The character of the single nutlet maturing is certainly of no value. On part of the type preserved in the herbarium of the University of California some fruits were found with three nutlets. In another collection of similar general appearance four mature nutlets were found.

Other varieties may need to be characterized from time to time. A study of the different varieties in intermediate ranges should prove of great interest to local botanists.

2. C. pustulosa (Rydb.) new comb.

Oreocarya pustulosa Rydb. Bull. Torr. Bot. Club **40**: 480. 1913.

Perennial; stems slender, branched at the base, 3–5 dm. high, glabrous or nearly so throughout; leaves linear-oblanceolate, apparently not clustered at the base, numerous on the stems, 3–10 cm. long, acute or obtuse, glabrous and without pustules above, conspicuously and densely pustulate and short-hairy below; inflorescence confined to the upper ¼ or less of the stem, cymes elongating and probably lax in age, foliar bracts inconspicuous; sepals lanceolate, acute, about 4 mm. long in anthesis, probably not conspicuously elongated in fruit, strigose and rather sparsely setose with short, appressed bristles; corolla white, tube 2.5–3

mm. long, somewhat shorter than the sepals in anthesis, crests at the base of the tube evident but not large, fornices about 1 mm. long, slightly papillose, probably yellow, limb 5–6 mm. broad, tube and limb subequal, lobes united for ¼ their length; mature fruit not seen, presumably very like *C. Jamesii*.

Distribution: Upper Sonoran Zone, southeastern Utah. Type: "Hammond Canyon, Elk Mountains, July 31, 1911, *Rydberg & Garrett 9320*."

Specimens examined:

Utah: Hammond Canyon, Elk Mts., Aug. 10, 1911, *Rydberg & Garrett 9569* (R.Mt., U.S.).

This species is quite unlike any other species of the genus in general appearance, due chiefly to the absence of any conspicuous setae and the quite glabrous stems and upper surfaces of the leaves. The original description characterizes the leaves as being "glabrous beneath, sparingly hairy above." In the specimen at hand it is certainly the upper leaf-surface that is glabrous. The specimen available of this species has more the appearance of a *Heliotropium* or of a *Plagiobothrys* than a *Cryptantha* but there seems no doubt that it is correctly placed in the latter genus. The variety *disticha* of *Jamesii* is probably something of a connecting link between *Jamesii* var. *multicaulis* and the present species.

3. C. Palmeri (Gray) new comb.

Krynitzkia Palmeri Gray, Proc. Am. Acad. **20**: 278. 1885.

Oreocarya Palmeri (Gray) Greene, Pittonia **1**: 57. 1887.

Caespitose, long-lived perennial; stems erect, rather stout, 15–30 cm. tall, densely setose with long, rather slender, divaricate hairs; radical leaves linear to linear-oblanceolate, acute, 4–7 cm. long, 2–7 mm. broad, tomentulose and subappressed-setose, abundantly pustulate on the dorsal surface, pustules smaller and fewer on the ventral surface; cauline leaves similar but smaller; inflorescence conspicuously, but rather softly, setose, mainly limited to the upper ¼ of the stem, cymes elongating, foliar bracts inconspicuous; calyx setose, sepals in anthesis linear-lanceolate, acute, about 5 mm. long, in fruit 7–10 mm. long, exceeding the nutlets by 6–8 mm.; corolla probably white, tube 4–5

mm. long, equalling or shorter than the calyx lobes in anthesis, crests lacking at the base of the tube, fornices elongated, papillose, 0.5–1 mm. long, limb about 8 mm. broad, lobes united for ⅓–½ their length, shorter than the tube; fruit strongly oblate-ovoid, all 4 nutlets maturing, style exceeding the nutlets by 3–4 mm.; nutlets very similar to those of *C. Jamesii*, about 3 mm. long, apex acute, margins not in contact, acute, all surfaces smooth, glossy, scar straight, closed or nearly so, extending from the base to beyond the middle, margin not elevated.

Distribution: Lower Sonoran Zone in western Texas and adjacent Mexico. Type: "Coahuila, Mexico, forty miles south of Saltillo, *Dr. Palmer*, March, 1880, no. *895* of the distribution."

Specimens examined:

Texas: rocky hills near Big Spring, Howard Co., June 11, 1900, *Eggert* (Mo., Gray); sandy hills and plains, Upper Concho, April, *Reverchon 2120* (Minn., Field, N. Y., Mo., U.S., Gray); Toyah, Reeves Co., May 2, 1902, *Tracy & Earle 424* (U.S.); from western Texas to El Paso, May–Oct. 1849, *Wright 489* (U.S., Gray).

Coahuila: 40 miles south of Saltillo, March, 1880, *Palmer 895* (Gray, TYPE).

This species has long remained obscure because of the immaturity of the type. The author had designated the plant collected by Reverchon (no. 2120) as the type of a new species before he had examined the type of *C. Palmeri*. Dr. Gray had described *Palmeri* as having subrugose nutlets and this is not true of the Reverchon plant. With the type of *Palmeri* at hand it is evident that the nutlets are subrugose only because they are immature. The other floral characters of *Palmeri* agree very well with the Texan specimen, and it seems very certain that at last the identity of *Palmeri* has been established.

This species is very close to *Jamesii* var. *multicaulis* and is certainly to be considered as a recent derivative from it. Its distinguishing characters are: (1) the accrescent sepals, (2) the corolla tube with no crests at the base, (3) the longer style.

4. C. oblata (Jones) new comb. Plate 25, figs. 5–7.

Krynitzkia oblata Jones, Contr. West. Bot. **13:** 4. 1910.

Oreocarya hispidissima Wooton & Standley, Contr. U. S. Nat. Herb. **19:** 545. 1915, not *O. hispidissima* (Torr.) Rydb.

O. oblata (Jones) Macbr. Proc. Am. Acad. **51:** 548. 1916.

O. Paysonii Macbr. Contr. Gray Herb. **48:** 36. 1916 (Type: limestone hills, Berendo Creek, Sierra Co., New Mexico, May 12, 1905, *Metcalfe 1576*).

Caespitose perennial; stems several to many from the base, rather slender, 1.5–2.5 dm. high, hirsute and becoming more conspicuously setose upwards; leaves tufted at the base, linear-oblanceolate, usually acute, 5–10 cm. long, dorsal surface rather coarsely strigose and appressed setose, pustules rather numerous, ventral surface more finely strigose, weakly and sparsely appressed-setose, sparingly pustulate; petioles more or less ciliate toward the base; inflorescence confined to the upper ½ of the stem, cymes somewhat elongated in age and so the thyrsus not very narrow, densely setose with rather slender bristles, foliar bracts inconspicuous; calyx abundantly setose with rather weak bristles, sepals in anthesis nearly linear, 6–7 mm. long, acute, in fruit 10–12 mm. long, exceeding the nutlets 7–8 mm.; corolla white, tube 8–10 mm. long, exceeding the sepals by 2–3 mm., crests lacking at the base of the tube, fornices probably yellow, rounded, broad and low (0.5–1 mm.), minutely papillose, limb 8–10 mm. broad, lobes united for about ¼ their lengths, scarcely half as long as the tube; fruit oblate-ovoid, all four nutlets usually maturing, style exceeding the mature nutlets by 3–5 mm. (species evidently moderately heterostyled); nutlets 2.5–3 mm. long, ovate or nearly circular in outline, obtuse at the apex, margins acute, not quite in contact, surfaces of nutlets glossy, the dorsal rather sparsely tuberculate and more or less rugose, these elevations low and rounded, ventral surfaces smooth, scar closed, extending from the base to about the middle of the nutlet, no elevated margin present.

Distribution: Lower Sonoran Zone of southern New Mexico and adjacent Texas. Probably occurs also on the Mexican side of the Rio Grande near El Paso. Type: "no. *3759* [*M. E. Jones*], El Paso, Texas, April 23, 1884."

Specimens examined:

Texas: Marfa, March 26, 1919, *Hanson 399* (U. S., Gray); near J. Davis' R. C., West Texas, Sept. 1883, *Havard* (U.S.); Fort Bliss, April 22, 1915, *Carlson* (Gray); El Paso, April, 1881, *Vasey*

(Mo.); near El Paso, March, 1851, *Thurber 147* (Gray); El Paso, April 23, 1884, *Jones 3759* (Pomona, TYPE, R.Mt., U.S.); northern base of Chenate Mts., Sept. 1892, *Nealley 167* (Field, N.Y., U.S.).

New Mexico: 1851–52, *Wright 1566* (Field); mesa west of Organ Mts., May 6, 1906, *Standley* (U.S.); Organ Mts., April 4, 1903, *Wooton* (R.Mt., Pomona); Tortugas Mt., Aug. 29, 1902, *Wooton* (U.S.); Tortugas Mt., April 22, 1894, *Wooton* (U.S.); Organ Mts., March 30, 1905, *Wooton* (U.S.); Lake Valley, southern Sierra Co., 1915, *Beals* (U.S.); Berendo Creek, Sierra Co., May 12, 1905, *Metcalfe 1576* (Pomona, Field, Mo., U.S., Gray).

This species is readily distinguished from all other species by the combination of an exserted corolla tube and nutlets that are smooth on the inner surfaces and distinctly roughened on the outer. In general appearance it is not very unlike *C. Jamesii* var. *multicaulis* or var. *cinerea*. In the original description of *C. oblata*, Mr. Jones also cited a specimen from Peach Springs, Arizona. This proves on examination to be *C. Jamesii* var. *cinerea*.

C. oblata is most closely related to *C. Palmeri* and to *C. Jamesii* var. *multicaulis*. It differs from both in having exserted corolla tubes and somewhat roughened nutlets that are quite distinctly wing-margined.

5. C. confertiflora (Greene) new comb. Plate 25, figs. 8–10.

Krynitzkia leucophaea var. *alata* Jones, Proc. Calif. Acad. Sci. II. **5:** 710. 1895. (Type: "No. *5289t*, May 23, 1894, Johnson, Utah, 5,000 ft. alt., on sandstone cliffs," *M. E. Jones*).

Oreocarya confertiflora Greene, Pittonia **3:** 112. 1896.

O. leucophaea var. *confertiflora* (Greene) Parish, Erythea **7:** 95. 1899.

O. lutea Greene, Muhlenbergia **2:** 240. 1906; Brand, Fedde, Rep. Sp. Nov. **19:** 73. 1923. (Type: "no. 8211, collected May 9, on rocky slopes in Silver Canyon in the White Mountains, opposite Laws, Inyo County," California, *A. A. Heller*).

O. alata (Jones) A. Nels. Coulter & Nelson, Man. Cent. Rocky Mts., 417. 1909; Rydb. Fl. Rocky Mts. 725. 1917.

Long-lived perennial from a woody root; stems few to many

from a branching caespitose caudex, slender, simple, 15–50 cm. tall, densely white-hairy at base, appressed-strigose and sparingly setose upwards, bristles mostly appressed; leaves somewhat clustered near the base, linear-oblanceolate, acute, 3–10 cm. long, dorsal surface densely strigose and with rather numerous small appressed bristles with pustulate bases, ventral surface uniformly strigose, in age minutely pustulate, petioles ciliate; inflorescence mainly restricted to the upper ½ of the stem or less, usually distinctly glomerate, cymules short, foliar bracts inconspicuous, bristles yellowish in age, divaricate; calyx setose with rather short, weak bristles, sepals in anthesis linear-lanceolate, acute, 7–10 mm. long, in fruit 10–12 mm. long, exceeding the nutlets by about 6 mm.; corolla yellow, tube 9–13 mm. long, 2–3 mm. longer than the sepals, crests at base of the tube usually evident, confluent into a ring (sometimes obsolete), fornices broad, emarginate, about 1 mm. high, limb about 10 mm. broad, lobes united for about ¼ their length, about ⅓ as long as the tube; fruit broadly ovoid (nearly square in cross-section due to the flat dorsal surfaces of the nutlets), all four nutlets commonly maturing, style exceeding the nutlets 3–6 mm. (species conspicuously heterostyled); nutlets broadly ovate in dorsal view, obtuse or subacute, about 3 mm. long, nearly triangular in cross-section, somewhat papery margins in contact, acute, almost wing-margined, surfaces of nutlets glossy, smooth, scar straight, nearly closed, extending from near the base to above the middle of the nutlet, margin not elevated.

Distribution: Upper Sonoran Zone, western Utah, northern Arizona, southern Nevada, and the eastern desert region of southern California. Type: "at Cushenberry Springs on the north side of the San Bernardino Mountains, southern California," *S. B. Parish.*

Specimens examined:

Utah: Dutch Mt., Tooele Co., June 8, 1900, *Jones* (Pomona); Gold Hill, near Clifton, June 13, 1891, *Jones* (Pomona); Dugway, w. Utah, May 27, 1891, *Jones* (Pomona); Fish Springs, June 4, 1891, *Jones* (Pomona, R. Mt., Calif., Mo., U.S.); Elsinore, Sevier Co., June 13, 1899, *Jones* (Pomona); red sand, Springdale, May 17, 1894, *Jones 5261j* (Pomona, U.S.); Wa Wa, 30 miles west of

Frisco, June 25, 1906, *Jones* (Pomona); Vermilion, June 4, 1901, *Jones* (Pomona); canyon south of Glenwood, May 25, 1875, *Ward 108* (Mo., U.S., Gray); Johnson, May 23, 1894, *Jones 5289t* (Pomona); Johnson, June 20, 1890, *Jones* (Pomona); Silver Reef, May 3, 4, 1894, *Jones 5144* (Pomona, R.Mt., Calif., Mo., U.S.); Diamond Valley, May 16, 1902, *Goodding 814* (Pomona, R.Mt., Mo., U.S., Gray); Beaverdam Mts., May, 1874, *Parry 166* (Mo., Gray).

Arizona: 3 miles below Tanner's Crossing, Little Colorado, May 27, 1901, *Ward* (N. Y., U.S.); Red Canyon trail, Grand Canyon, June 10, 1901, *Ward* (U.S.).

Nevada: The Muddy Range, April 10, 1905, *Goodding 2221* (R.Mt., Minn., Mo., Gray); Mormon Mts., Lincoln Co., July, 1906, *Kennedy & Goodding 110* (Calif.); Meadow Valley Wash, mile 16, April 28, 1904, *Jones* (Pomona); Good Springs, May 1, 1905, *Jones* (Pomona); Good Springs, May, 1915, *K. Brandegee* (Calif.); Goldfield, May 14, 1909, *Heller 9619* (Phila.); Esmeralda Co., *Shockley* (Calif.).

California: Andrew's Camp, Bishop Creek, Inyo Co., July, 1911, *Davidson 2722* (Gray); Andrew's Camp above Bishop Creek, July, 1913, *K. Brandegee* (Pomona, Calif.); Bishop Creek, May 31, 1906, *Hall & Chandler 7234* (Calif.); northern slope of San Bernardino Mts., May, 1882, *Parish 1319* (Calif.); near summit of Wild Rose Canyon, Inyo Co., *Parish 19167* (Calif.); Cactus Flat, desert slope of San Bernardino Mts., June 2, 1901, *Parish 4887* (Calif., U.S.); San Bernardino Mts., June 17, 1894, *Parish 3240* (Mo., U.S.); Water Canyon, San Bernardino Mts., May, 1882, *Parish 1316* (Mo., Gray); near Cushenberry Springs, Mojave Desert, May, 1882, *Parish & Parish 1316* (Calif., Mo.); Erskine Creek, May, 1897 ('98?), *Purpus 5323* (Calif., Mo., U.S., Gray); White Mts., 1898, *Purpus 5802* (Calif., U.S.); Silver Canyon east of Laws, May 9, 1906, *Heller 8211* (Calif., Mo., Phila., U.S., Gray); south of Mono Lake, July 8, 1863, *Brewer 1822* (U.S.); Pleasant Canyon, Panamint Mts., May 6, 1897, *Jones* (Pomona, U.S.); Kern River, *Austin* (Calif.); Olancha Mt., Tulare Co., June 25–30, 1904, *Hall & Babcock 5270* (Calif.).

C. confertiflora and its close relatives, *C. flava* and *C. leucophaea*, are readily distinguishable from all other species of the section

by their long corolla tubes and smooth nutlets. They are not so easily separable from one another, however, and a broader specific concept would unite them as varieties of one species. The three units are definitely segregated geographically, and the morphological differences, when once noted, seem to be constant. The principal characteristics may be summarized as follows: *C. confertiflora* and *C. flava* have yellow flowers, while *C. leucophaea* has white ones. The nutlets in the first and last are definitely ovate in outline while in the second they are much narrower. The inflorescence in *confertiflora* is distinctly glomerate while in the related species it is continuous or nearly so.

Dr. Brand legally published the *nomen nudem Oreocarya lutea* Greene. He did this in the belief that *lutea* Greene was specifically distinct from *confertiflora*. He says "Macbride stellt in seiner im Jahre 1916 erschienen Monographie der Gattung *Oreocarya* den Namen *O. lutea* Greene als Synonym zu *O. confertiflora*. Aber abgesehen von der goldgelben Blütenfarbe sind bei *O. lutea* die Staubblätter an der Spitze des Kronentubus dicht unter den Hohlschuppen eingefügt, wahrend sie bei *O. confertiflora* (*O. flava*) in der mitte der Kronenrohre sitzen und von den Hohlschuppen durch einen deutlichen Zwischenraum getrennt sind." These differences in position of the stamens in the tube are obviously of no taxonomic value in the present case, since the present species is very definitely dimorphic as regards stamen insertion and length of style and both forms are commonly found growing in close proximity.

6. C. flava (A. Nels.) new comb. Plate 25, figs. 11–13.

Oreocarya flava A. Nels. Bull. Torr. Bot. Club **25:** 202. 1898.

O. lutescens Greene, Pittonia **4:** 93. 1899. (Type: "common on hills about Aztec, New Mexico, 25 April, 1899," *C. F. Baker*.)

Very similar in habit of growth to *C. confertiflora;* stems 15–35 cm. tall, bristles somewhat coarser and more widely spreading than in *confertiflora;* leaves linear or linear-oblanceolate, acute, 3–9 cm. long, dorsal surface densely appressed-strigose and with numerous small appressed bristles with pustulate bases, ventral surface uniformly strigose in age, with rather numerous pustulate hairs, petioles ciliate; inflorescence usually restricted to the upper

½–¾ of the stem, scarcely glomerate, indument very similar to that in *confertiflora*, possibly more strongly setose; calyx setose with rather strong divaricate bristles, sepals in anthesis linear-lanceolate or quite linear, acute, about 10 mm. long, in fruit scarcely enlarged, exceeding the nutlets by about 6 mm.; corolla yellow, tube 9–11 mm. long, 2–3 mm. longer than the sepals, crests at the base of the tube usually obsolete, rarely vestigial, fornices very similar to those in *confertiflora*, limb 8–9 mm. broad, lobes united for about ¼ their length, less than ½ as long as the tube; fruit lance-ovoid, usually less than 4 nutlets maturing (often only 1 or 2), style exceeding the nutlets 2–7 mm. (species conspicuously heterostyled); nutlets lanceolate in dorsal view, acute, 3–4 mm. long, firmer in texture than in *confertiflora*, margins in contact, acute, not wing-margined, surfaces of nutlets glossy, smooth, dorsal somewhat more rounded crosswise than in *confertiflora*, ventral not so distinctly keeled, scar similar.

Distribution: Upper Sonoran Zone in southern Wyoming, western Colorado, northwestern New Mexico, eastern Utah, and northeastern Arizona. Type: Point of Rocks, Sweetwater Co., Wyoming, June 1, 1897, *A. Nelson 3074*.

Specimens examined:

Wyoming: Alcova, Natrona Co., July 1, 1901, *Goodding 164*, (R.Mt., Pomona, Field, Mo., U.S., Gray); hills of the Platte in the mountains, *Nuttall* (Phila.); Cooper Creek, June 18, 1892, *Nelson 22* (Gray); Medicine Bow, July 9, 1898, *E. Nelson 4397* (R.Mt., Field); T. B. Ranch, Carbon Co., June 20, 1901, *Goodding 53* (R.Mt.); Ft. Steele, May 25–June 10, 1901, *Tweedy 4262* (U.S.); 3 miles north of Saratoga, July 3, 1922, *Payson & Payson 2533* (R.Mt., Pomona, Colo., Mo., Gray); Ft. Steele, June 16, 1907, *Nelson* (R.Mt.); northeast corner of Sweetwater Co., July 6, 1926, *Nelson 10693* (R.Mt.); Bitter Creek, June 16, 1898, *Nelson 4771* (R.Mt.); Bitter Creek, June 2, 1897, *Nelson 3098* (R.Mt.); Point of Rocks, June 1, 1897, *Nelson 3074* (R.Mt., TYPE); Steamboat Mt., Sweetwater Co., June 9, 1900, *Nelson 7067* (R.Mt., Pomona, Minn., Mo., U.S., Gray); 20 miles east of Point of Rocks, July 4, 1922, *Payson & Payson 2557* (R.Mt.); near Leucite Hills, June 17, 1901, *Merrill & Wilcox 497* (R.Mt., U.S., Gray); same locality and date, *486* (U.S.); near Washington's

Ranch, June 30, 1901, *Merrill & Wilcox 726* (R.Mt., U.S., Gray); Rock Springs, July 7, 1925, *Payson & Payson 4307* (R.Mt.); Green River, June 23, 1896, *Jones 6725* (Pomona).

Colorado: 8-10 miles west of Craig, June 17, 1925 *Osterhout 6389* (R.Mt.); Grand Junction, May 17, 1892, *Eastwood* (Calif., Mo., U.S., Gray); Grand Junction, May 28, 1894, *Crandall* (Calif.); Grand Junction, June 20, 1898, *Bethel* (Colo.); Grand Junction, June 19, 1915, *Macbride & Payson 705* (R.Mt., Gray); Dolores River near Mesa Creek, June 11, 1914, *Payson 405* (R. Mt., Gray).

New Mexico: Aztec, April, 1899, *Baker 562* (Pomona, R.Mt., Calif., Mo., Gray); Fort Defiance, 1869, *Palmer* (U.S.).

Utah: Uinta Mts., 1902, *Langille 117* (U.S.); Myton, May 20, 1908, *Jones* (Pomona); Theodore to Myton, May 19, 1908, *Jones* (Pomona); between the K. Ranch and Jensen, June 18, 1925, *Osterhout 6406* (R.Mt.); Price, June 10, 1900, *Stokes* (Calif.); Green River, June 12, 1901, *Stokes* (Minn., U.S.); Green River, May 8, 1909, *Tidestrom 2031* (U.S.); Thompson's Springs, May 3, 1891, *Jones* (Pomona); Thompson's Springs, May 7, 1891, *Jones* (R.Mt.); Moab and vicinity, July 1–2, 1911, *Rydberg & Garrett 8431* (N.Y.); Cisco, May 2, 1890, *Jones* (Pomona, R.Mt., Calif.); San Rafael Swell, May 15, 1914, *Jones* (Pomona); in clay, near Orangeville, June 18, 1894, *Jones 5464* (Pomona, Calif., Mo., U.S.); 2 miles north of Ferron, June 18, 1894, *Jones 5455c* (U.S., Pomona).

Arizona: 5 miles east of Tuba, May 30, 1901, *Ward* (N.Y., U.S.); plants of the Hopis, *Voth 103, 15* (Field); Adamana, Petrified Forest, June 27, 1913, *Hitchcock 7* (U.S.).

The interpretation here given to *flava* is somewhat more inclusive than that in Macbride's revision inasmuch as Macbride referred all plants from western Colorado to *confertiflora* while they are now placed in *flava*. The characters ascribed to the two species by Macbride are those accepted here. The discrepancy in range is probably due to the comparative immaturity and paucity of the specimens cited by Macbride from Colorado. For a discussion of the distinction between *flava* and related species see under *C. confertiflora*.

7. C. leucophaea (Dougl.) new comb. Plate 25, figs. 14–16.
Myosotis leucophaea Dougl. in Lehm. Pug. **2:** 22. 1830.
Eritrichium leucophaeum (Dougl.) A.DC. Prodr. **10:** 129. 1846.
Krynitzkia leucophaea (Dougl.) Gray, Proc. Am. Acad. **20:** 280. 1885.
Oreocarya leucophaea (Dougl.) Greene, Pittonia **1:** 58. 1887.
Very similar in habit of growth to *C. confertiflora;* stems 15–40 cm. tall, white-hairy at the base, densely strigose but scarcely setose upwards except in the inflorescence; leaves linear to linear-oblanceolate, acute, 3–9 cm. long, dorsal surface densely strigose and with numerous weak bristles with pustulate bases, ventral surface uniformly strigose, pustules few or none, leaf-bases and petioles ciliate; inflorescence mainly restricted to upper ½ of the stem, scarcely glomerate, indument rather softly setose, bristles divaricate, white, not turning yellowish in age; calyx setose with rather weak bristles, sepals in anthesis linear or nearly so, acute, about 10 mm. long, in fruit 13–14 mm. long, exceeding the nutlets by 7–8 mm.; corolla white, tube 8–11 mm. long, 1–2 mm. longer than the sepals, crests at the base of the tube evident, fornices linear-oblong, emarginate, 1 mm. long, probably yellow, limb 8–10 mm. broad, lobes united about ¼ their length, less than half as long as the tube; fruit ovoid, usually less than 4 nutlets maturing, style exceeding the mature nutlets 1.5–7 mm. (species heterostyled); nutlets ovate, acute, 3–4 mm. long, rather thin, margins in contact, acute, almost wing-margined (less so than in *C. confertiflora*, more than in *C. flava*), surfaces of nutlets glossy, smooth, scar as in *C. confertiflora.*

Distribution: Upper Sonoran Zone in south-central Washington—reported from southern British Columbia (Macoun, Cat. Canad. Pl. **2:** 338. 1884, and Henry, Fl. Southern British Columbia, 254. 1915), and probably to be found in northern Oregon. Type: "arid barrens of the Columbia, and of its northern and southern tributaries." Collected by *Douglas.*

Specimens examined:

Washington: "ex dupl. Hook." *Douglas* (Gray); Columbia River from lat. 46° to 49° N., 1860, *Lyall* (Gray); near Morgan's Ferry, Yakima River, June 8, 1884, *Suksdorf 407* (Gray); near Egbert Spring, Douglas Co., July 4, 1893, *Sandberg & Leiberg 373*

(Wash., Pomona, R.Mt., Calif., Minn., Field, Mo., Phila., U.S., Gray); Pasco, May 26, 1899, *Piper 2987* (Wash.); Pasco, July 11, 1897, *Piper* (R.Mt.); Pasco, May 20, 1899, *Piper 2987* (Gray); Pasco, May 25, 1896, *Hindshaw 2* (Wash.); Pasco, July, 1898, *Elmer 1056* (Wash., Minn., U.S.); Scott, Klickitat Co., May 16, 1898, *Leckenby* (Wash.); 2 miles s.w. of Attalia, May 6, 1911, *Beattie 3921* (Wash.); Burbank, Walla Walla Co., May 29, 1922, *Lechiner 3* (Wash.); Walla Walla region, June, 1883, *Brandegee 997* (Phila., Calif., Gray); Wallula, May 23, 1903, *Cotton 1027* (Wash., U.S., Gray).

For a discussion of the differences between this species and the closely related ones see under *C. confertiflora*. *C. leucophaea* is of especial interest because it is so widely separated geographically from its very near allies.

8. C. salmonensis (Nels. & Macbr.) new comb.

Plate 25, figs. 17–19.

Oreocarya salmonensis Nels. & Macbr. Bot. Gaz. **61**: 43. 1916.

Perennial and caespitose; stems rather stout, 1.5–3 dm. high, setose with rather weak, white hairs, as well as strigose-tomentulose; leaves rather narrowly oblanceolate to spatulate, clustered at the base, numerous upwards, acute or obtuse, more or less tomentulose on both surfaces, setose with rather weak hairs, pustulate dorsally and ventrally; inflorescence on upper ½ of the stem, rather narrow or sometimes broader by the elongation of the cymules, foliar bracts not conspicuous; calyx abundantly setose with white, rather slender hairs; sepals in anthesis linear-lanceolate, acute, about 3 mm. long, in fruit 5–7 mm. long, exceeding the nutlets by about 3 mm.; corolla white, tube 3 mm. long, equalling or slightly shorter than the sepals, slightly shorter than the limb, crests at the base of the tube well developed, fornices distinctly papillose, probably yellow, 0.5–1 mm. long, emarginate, limb 8–10 mm. broad, lobes united for about ⅓ their length; fruit lanceolate-ovoid, 3–4 nutlets usually maturing, style 1.5 mm. longer than the mature nutlets; nutlets lanceolate, obtuse, 3–4 mm. long, with margins in contact, rather indefinitely wing-margined, all surfaces smooth, glossy, scar straight, closed, extending the full length of the nutlets, no elevated margin evident.

Distribution: Upper Sonoran areas in central Idaho. Type: *Charles L. Kirtley*, Salmon, Idaho.

Specimens examined:

Idaho: Salmon, June, 1896, *Kirtley* (R.Mt., TYPE); Salmon, July 3, 1920 *Payson & Payson 1880* (R.Mt., Mo., Gray); Challis, July 21, 1916, *Macbride & Payson 3348* (R.Mt., U.S., Mo., Gray).

There can be no doubt as to the right of this plant to specific recognition. It is perhaps most closely related to *C. leucophaea* but is at once separable from that by the short corollas, the more hispid indument, and the broader leaves.

9. C. stricta (Osterhout) new comb. Plate 26, figs. 20–22.

Oreocarya stricta Osterh. Bull. Torr. Bot. Club **50**: 217. 1923.

Perennial; stems solitary or 2 or 3 from a tap-root, rather slender, strictly erect, 1.5–3 dm. high, conspicuously setose with strong, divaricate bristles and sparsely retrorse-strigose; leaves clustered at the base of the stem, oblanceolate, usually acute, 2–5 cm. long, conspicuously veined longitudinally, strongly setose with spreading bristles and strigose pustulate hairs about equally numerous on both leaf surfaces, cauline leaves similar to the basal, reduced upwards; inflorescence apparently rather narrow and crowded, extending over the upper ¼ or ⅓ of the stem, densely setose, foliar bracts quite small and inconspicuous; calyx strigose and setose with spreading bristles, sepals narrowly lanceolate, acute, 4–5 mm. long in anthesis, 6–8 mm. long in fruit, exceeding the nutlets by about 3 mm.; corolla quite yellow in dried material but Mr. Osterhout believes it to have been white with yellow fornices, tube 3.5 mm. long, equalling or shorter than the sepals, crests well developed at the base of the tube, fornices low, rounded, limb 8–10 mm. broad, tube and limb subequal, lobes united for ¼ to ⅓ their length; fruit lanceolate-ovoid, all four nutlets usually maturing, style exceeding the mature nutlets 1–1.5 mm.; nutlets lanceolate or elliptical, obtuse or subacute, with margins in contact, narrowly winged, acute, surfaces of nutlets glossy, the dorsal definitely rugose and sometimes tuberculate, not muricate, ventral surfaces smooth or nearly so, scar straight, extending from the base to near the apex, nearly closed, no elevated margin present.

Distribution: Upper Sonoran Zone, northwestern Colorado. Type: collected "some distance south of the Yampa or Bear River in Moffat County (Colorado) along the Victory Highway."

Specimens examined:

Colorado: some distance south of the Yampa River along the Victory Highway, June 21, 1922, *Osterhout 6195* (R.Mt., Osterh., TYPE, Gray).

C. stricta is a very distinct species and although only known at present from a single collection, must take its place as one of the major units in any study of the genus. It is difficult to say to what species it is most closely allied. The nutlet characters would place it nearest to *C. nubigena* but it is more than probable that these similarities represent merely a convergent development rather than an actual immediate relationship. *C. stricta* may represent a separate line of evolution from *C. Jamesii* var. *multicaulis* or an offshoot from the *confertiflora-flava* branch.

10. C. nubigena (Greene) new comb. Plate 26, figs. 23–25.
Oreocarya nubigena Greene, Pittonia **3:** 112. 1896.

Perennial and caespitose from a woody root; stems several, slender or rather stout, 16–20 cm. high, setose and hirsute, bristles divaricate; leaves oblanceolate to spatulate, obtuse, tapering gradually to a somewhat ciliate petiole, 2–4 cm. long, setose with curved bristles, hirsute and more or less tomentulose, pustulate bases to the bristles present on both surfaces, more abundant and earlier evident on the dorsal surface; inflorescence confined to the upper ½ or less of the stem, narrow, somewhat glomerate or compact, foliar bracts inconspicuous, densely setose; calyx setose with divaricate or somewhat reflexed bristles, hirsute, sepals in anthesis linear-lanceolate, somewhat obtuse at the very tip, 3–4 mm. long, in fruit 7–9 mm. long, exceeding the nutlets by 2–3 mm.; corolla white, tube 3–4 mm. long, equalling the calyx lobes, crests at base of the tube evident, fornices prominent, broad, papillose, yellow, about 0.5 mm. high, limb 4–7 mm. broad, lobes slightly shorter than the tube (measuring from the fornices), united for about ⅓ their length; fruit elongated and narrowly ovoid, all 4 nutlets commonly maturing, style equalling the mature nutlets or exceeding them 0.5–1.5 mm.; nutlets narrowly

lanceolate, acute or obtuse, 4–5 mm. long, somewhat glossy, margins in contact, acute, apices spreading, dorsal surface of nutlets nearly smooth or (usually) indefinitely rugose and tuberculate, somewhat margined, ventral surface smooth or indistinctly wrinkled, scar narrow, straight, extending from near the base nearly to the apex.

Distribution: in the high mountains, south-central Idaho, northwestern Nevada, Oregon and northern and eastern California. Type: "On Cloud's Rest, Mariposa Co., California, 10 July, 1889," *Messrs. Chestnut & Drew.*

Specimens examined:

Idaho: Smoky Mts., Blaine Co., Aug. 13, 1916, *Macbride & Payson 3771* (R.Mt., Mo., U.S., Gray).

Nevada: Santa Rosa Mts., July 11, 1898, *Cusick 2028* (R.Mt., Calif., Minn., Mo., U.S., Gray).

Oregon: Pine Creek, Baker Co., Sept. 1879, *Cusick* (Gray); dry banks above the John Day River, Prairie City, Grant Co., July 1, 1919, *Ferris & Duthie 734* (R.Mt.); Warner Mts., July 1898, *Austin & Bruce 2270* (Pomona); Crater Lake, Sept. 14, 1902, *Coville 1514* (U.S.).

California: Scott's Mt., north Calif., Aug. 30, 1880, *G. Engelmann* (Mo.); Mt. Eddy, Siskiyou Co., July 9, 1920, *Heller 13435* (Field, N. Y., Mo., U.S.); head North Fork, Parker Creek, Warner Mts., Modoc Co., July 13, 1910, *Taylor & Bryant* (Calif.); mountain near Sonora Pass, July 16, 1863, *Brewer 1887* (Calif.); summit of Cloud's Rest, July 13, 1889, *Chestnut & Drew* (Calif.).

It is not felt that the treatment here accorded *nubigena* is particularly satisfactory. The specimens at hand are comparatively few and from widely separated localities. They are not particularly homogeneous among themselves. It is possible that the species may be separable into several geographic varieties when it is better known. Perhaps it is simply an especially polymorphic unit and any one locality will give great extremes of variation. Even its relationship to other species is not clear.

Because of its range and habitat, *nubigena* is most likely to be confused with *humilis*. That it is really closely related to it is not so certain. The outstanding peculiarities of *nubigena* are its greatly elongated nutlets that are nearly smooth on the inner sur-

faces. A satisfactory concept of this species must await further study and exploration.

11. C. Clemensae Payson[1] Plate 26, figs. 26–28.

Perennial, probably short-lived; stems numerous from the rather slender root, the underground portions densely clothed with the leaves of previous years, very slender, 6–12 cm. high, setose; leaves narrowly oblanceolate or spatulate, rather thin, 2–3 cm. long, obtuse or subacute, rather sparsely hairy with spreading, hirsute trichomes and small, pustulate setae, both surfaces pustulate, the upper much less densely so than the lower; inflorescence subcapitate, rarely over 3 cm. long, foliar bracts inconspicuous; calyx densely setose with rather slender bristles, rather sparsely strigose, sepals in anthesis 3–4 mm. long, linear-lanceolate, in fruit about 7 mm. long, exceeding the nutlets by 3–4 mm.; corolla white, tube 2.5 mm. long, shorter than the sepals in anthesis, crests at the base of the tube evident, fornices well developed, probably white, 0.5–1 mm. long, scarcely papillose, limb about 4 mm. broad, tube distinctly longer than the limb, lobes united for about ⅓ their length; fruit elongated and narrowly ovoid, all four nutlets commonly maturing, style exceeding the mature nutlets by 0.5–1 mm., margins in contact or nearly so, acute; nutlets somewhat papery, linear-lanceolate, acute, 3 mm. long, very definitely but narrowly wing-margined, surfaces slightly glossy, the dorsal sparsely tuberculate, the tubercles low and sometimes elongated but apparently not often forming rugae, ventral surfaces nearly smooth except for the veining of the pericarp, scar straight, extending from near the base nearly to the apex, open but narrow, no elevated margin present.

[1] **Cryptantha Clemensae** sp. nov., perennis; caulibus multis gracilibus setosis 6–12 cm. altis; foliis anguste oblanceolatis aut spathulatis tenuibus obtusis aut subacutis hirsutis et setosis supra et subter pustulosis; inflorescentibus subcapitatis; sepalis setosis linearo-lanceolatis 3–4 mm. longis, fructiferis ca. 7 mm. longis, quam nuculae 3–4 mm. longioribus; corolla alba, tubo 2.5 mm. longo, quam sepalis brevioribus, limbo ca. 4 mm. lato; stylo nuculas 0.5–1 mm. superante; nuculis linearo-lanceolatis acutis 3 mm. longis anguste alatis, facie exteriore sparse tuberculosis, faciebus ventralibus fere laevibus, sulco recto angusto, margine non edito.—Collected by *Mrs. Joseph Clemens*, Glenn's Pass, California, July 22, 1910, (R. Mt. Herb., TYPE).

Distribution: in the southern Sierra Nevada of California. Type: Glenn's Pass, California, July 22, 1910, *Mrs. Joseph Clemens.*

Specimens examined:

California: Glenn's Pass, July 22, 1910, *Clemens* (R.Mt., TYPE, Pomona); Mt. Whitney, July 11, 1910, *Clemens* (Pomona); near Mt. Whitney, Sept. 1, 1891, *Bailey, Coville & Funston* (U.S.); Mt. Whitney, alt. 13,000 ft., Aug. 17, 1899, *Copeland 52* (U.S.).

Presumably this species is most closely related to *C. nubigena*, and its geographical location and habitat make it reasonable to suppose that it is a derivative from that plant. From *nubigena*, *C. Clemensae* is very different in general appearance. The thin, green and rather flaccid leaves give it an appearance that is quite unusual in the genus. The small, rather turgid but narrowly winged nutlets are also quite characteristic. It seems as distinct a unit as has been described in the genus; indeed the author's chief hesitation in describing the plant has been because it seemed so aberrant in the section *Oreocarya* that it might be best placed in some other group. A study of the flowers and fruit seems to make it certain that it must be placed in *Cryptantha*, and the perennial root and compact inflorescence definitely place this plant in the section *Oreocarya*.

The species is named in honor of the indefatigable collector, Mrs. Joseph Clemens.

Series 2. VIRGATAE. Stout, erect biennials or perennials with unbranched stems. Nutlets smooth, or nearly so, on the ventral surfaces, variously roughened on the dorsal — or in some forms of *C. virgata* — quite smooth. Species 12–13.

12. C. setosissima (Gray) new comb. Plate 26, figs. 29–31.
Eritrichium setosissimum Gray, Proc. Am. Acad. **12**: 80. 1877.
Krynitzkia setosissima Gray, Proc. Am. Acad. **20**: 276. 1885.
Oreocarya setosissima (Gray) Greene, Pittonia **1**: 58. 1887.

Short-lived perennial or possibly a biennial from a stout taproot; stem usually solitary, unbranched, stout, 2.5–8 dm. tall, setose and hirsute; leaves clustered at the base, linear-oblanceolate, obtuse, the lower 6–12 cm. long, somewhat reduced up-

wards, setose and hirsute, bristles not so coarse nor so widely spreading as in *C. virgata*, pustulate hairs numerous on both surfaces but more numerous dorsally; inflorescence rarely extending over more than ½ of the stem, foliar bracts scarcely exceeding the branches of the inflorescence, this elongating and spicate rather than glomerate; calyx densely hirsute and setose; sepals in anthesis lanceolate, acute or obtuse, about 6 mm. long, in fruit linear-lanceolate, acute or obtuse, about 10 mm. long, exceeding the nutlets by about 5 mm.; corolla white, tube about 4 mm. long, equalled by the calyx lobes, constricted above the ovary with a thickened ring of crests, fornices distinctly emarginate, 0.5 mm. high, probably yellow, limb about 8 mm. broad, lobes united about 1/6 their length; fruit ovoid, all four nutlets commonly maturing, style exceeding the nutlets by 1.5 mm.; nutlets in contact, ovate, obtuse, 4–5 mm. long, papery rather than bony, surrounded by a conspicuous wing-margin nearly 1 mm. wide, surfaces somewhat glossy, dorsal uniformly and openly muriculate with a few larger tubercles or short rugae, ventral surface smooth or nearly so, scar straight, narrow, open, extending from very near the base to near the apex.

Distribution: Transition Zone from south-central Utah to southern Arizona. Type: "shores of Fish Lake, Utah, at 8,700 feet, *L. F. Ward,*" in Powell's Expedition, 1875.

Specimens examined:

Utah: Bromide Pass, Henry Mts., July 27, 1894, *Jones 5692al* (U.S.); Panguitch Lake, Sept. 7, 1894, *Jones 6015al* (Pomona, U.S.); Fish Lake, Aug. 9, 1894, *Jones 5790m* (Pomona, U.S.); Fish Lake, Aug. 10, 1894, *Jones 5812* (Pomona, R.Mt., Calif., Mo., U.S.); Fish Lake, Aug. 25, 1875, *Ward 646* (Phila., Mo., U.S., Gray, TYPE); St. George, 1877, *Palmer 357* (Mo., Gray).

Arizona: Grand Canyon of the Colorado, June 26, 1898, *MacDougal 165* (R.Mt., Calif., Phila., U.S., Gray); Grand Canyon, July 9, 1892, *Toumey 224* (U.S.); rim of Grand Canyon, July 12, 1892, *Wooton* (U.S.); San Francisco Mts., Sept. 1884, *Lemmon & wife* (Calif.); San Francisco Peaks, July 26, 1901, *Leiberg 5748* (U.S.); Flagstaff, Aug. 7, 1884, *Jones 6686* (Pomona); Flagstaff, May–Oct. 1900, *Purpus 8048* (Pomona, Calif., Mo., U.S.); Flagstaff, Aug. 1883, *Rusby 748* (Calif., Phila., U.S.); Mt. Hum-

phrey, July 26, 1897, *Kunze* (N.Y.); Bill Williams Mt., July 5, 1889, *Greene* (Calif., U.S.); Nagle's Ranch (northwestern Arizona), Sept. 17, 1894, *Jones 6054s* (U.S.); Ft. Apache, June 21–30, 1890, *Palmer 591* (Calif., Gray, U.S., in part); 66 miles south of Holbrook, July 4, 1901, *Hough 88* (U.S.); Thompson's Ranch, Black River, White Mts., July 14, 1910, *Goodding 589* (R.Mt., U.S., Gray); White Mts., Aug. 6–15, 1903, *Griffiths 5300* (U.S.); near Santa Catalina Mts., Aug. 1881, *Lemmon & wife* (R.Mt.).

This is certainly one of the most distinct units in the section *Oreocarya*. It is remarkably uniform in character and is to be confused with no other species. In general appearance it is somewhat similar to *C. virgata*, and for that reason is associated with it in the series. This resemblance may be no indication of real relationship. The nutlets of certain annual species of *Cryptantha*, notably *C. utahensis*, *C. holoptera*, and *C. pterocarya*, are remarkably similar to those of *C. setosissima* and suggest the possibility that some of the annual forms of the genus may have developed from perennial forms in North America. It was doubtless this similarity of nutlets that led Greene (Pittonia **1**: 58. 1887) to transfer one of the annual species to *Oreocarya*. This was *O. holoptera* (Gray) Greene; now treated as *Cryptantha holoptera* (Gray) Macbride.

13. C. virgata (Porter) new comb. Plate 26, figs. 32–34.

Eritrichium virgatum Porter, Hayden Rept. 479. 1870.

E. glomeratum var. *virgatum* Porter in Porter & Coulter, Syn. Fl. Colo. 102. 1874.

Krynitzkia virgata (Porter) Gray, Proc. Am. Acad. **20**: 279. 1885.

Oreocarya virgata (Porter) Greene, Pittonia **1**: 58. 1887.

O. spicata Rydb. Bull. Torr. Bot. Club **36**: 678. 1909. (Type: Artist's Glen, Pikes Peak, Colorado, Aug. 1, 1901, *Clements 102*.)

O. virgata forma *spicata* (Rydb.) Macbr. Proc. Am. Acad. **51**: 546. 1916.

Biennial from a stout taproot; stem usually solitary, unbranched, stout (when the terminal bud is injured a number of rather slender stems may be developed), 2.5–7 dm. tall, densely setose with long, stout, divaricate bristles, hirsute; leaves narrowly

oblanceolate, obtuse, 3–12 cm. long, hirsute and setose, appressed pubescence lacking, pustulate hairs numerous on both surfaces but somewhat more numerous dorsally; inflorescence usually extending along at least ¾ of the stem, uniformly cylindrical in outline, conspicuously bracteate with linear-oblanceolate foliar bracts that much exceed the cymules in length; calyx setose and hirsute, indument not essentially different from that of the leaves, sepals in anthesis lanceolate, acute, 4 mm. long, in fruit linear-lanceolate, acute or slightly obtuse, 11 mm. long, exceeding the nutlets by about 6 mm.; corolla white, tube about 3.5 mm. long, slightly exceeded by the calyx lobes, with a conspicuous thickened ring of crests just above the ovary, fornices papillose, yellow, distinctly emarginate, 0.5 mm. high, limb 8–10 mm. broad, lobes united about ⅓ their length; fruit broadly ovoid, all four nutlets commonly maturing, style exceeding the nutlets 1.5–2 mm.; nutlets in contact, ovate, obtuse, 2.5–3.5 mm. long, with an indistinct thinner margin, surfaces somewhat glossy, dorsally sparingly tuberculate and usually more or less rugose with low, rounded rugae (smooth in forma *spicata*), ventrally nearly smooth, often with a few indistinct tubercles or rugae, scar straight, nearly or quite closed, extending from about 1/5 the distance from the base to about the same distance from the apex.

Distribution: Transition Zone, eastern foothills of the Rocky Mountains, southeastern Wyoming to south-central Colorado; also in North Park, Colorado. Type: "near Denver, Colorado Territory, 1869," *B. H. Smith.*

Specimens examined:

Wyoming: Sheep Mt., Albany Co., June 24, 1925, *Payson & Payson 4248* (R.Mt.); Chug Creek, Albany Co., June 29, 1900, *Nelson 7338* (R.Mt., Pomona, Minn., Mo., U.S., Gray); Telephone Canyon, Albany Co., June 15, 1894, *Nelson 231* (R.Mt., Minn., Mo., U.S., Gray); Laramie Hills, June 13, 1896, *Nelson 1937* (R.Mt., Minn., Mo.); Centennial Valley, June 8, 1895, *Nelson 1267* (R.Mt., Wash.).

Colorado: Walden, June 25, 1925, *Payson & Payson 4253* (R.Mt.); King's Canyon, Jackson Co., June 25, 1925, *Payson & Payson 4291* (R.Mt.); Horsetooth Gulch, June 30, 1893, *Baker* (Pomona); foothills, Larimer Co., May 25, 1895, *Osterhout*

(R.Mt.); Front Range, July 2, 1896, *Crandall* (R.Mt., Wash., Calif., Mont.); Estes Park, July 12, 1904, *Cooper 117* (R.Mt.); St. Vrain Creek, June 9, 1906, *Dodds 1832* (R.Mt.); Estes Park, Aug. 1895, *Osterhout* (Minn.); Boulder, June 24, 1901, *Osterhout 2463* (Pomona, Calif., Gray, Osterh.); between Tolland and Rollinsville, July 8, 1913, *Overholts 10155* (Calif.); near Boulder, June 10, 1905, *Ramaley 1078* (R.Mt.); near Boulder, July 9, 1900, *Ramaley A.107* (R.Mt.); near Boulder, July, 1902, *Tweedy 5223, 5222* (R.Mt.); near Boulder, June, 1903, *Tweedy 5676* (R.Mt.); Georgetown, July and Aug. 1885, *Patterson 110* (Calif., Phila., Mo., U.S., Gray); near Golden, June 24, 1878, *Jones 296* (Pomona); Green Mt. Falls, Ute Pass, Aug. 2, 1892, *Sheldon 216* (U.S.); Colorado Springs, June 2, 1879, *Jones* (R.Mt., Pomona, U.S.); Pikes Peak region, July 27, 1920, *Johnston 2818* (Gray); Artist's Glen, Pikes Peak, Aug. 1, 1901, *Clements & Clements 102* (R.Mt., Minn., Mo., U.S., Gray); mountains n.e. of Canyon City, 1874, *Brandegee 898* (Mo.).

C. virgata is one of the most conspicuous herbaceous plants on the eastern foothills of the Rocky Mountains in eastern Colorado. The strictly erect, rod-like stems with the closely set white flowers are unique. The numerous elongated leaf-like bracts of the inflorescence add to the peculiar appearance and serve to separate the species from its relatives. Its relationship to *C. setosissima* is decidedly problematical. Although it was for a time held to be a variety of *Bradburiana* there is no reason to believe it is really related to that plant.

Additional evidence is at hand to support Macbride's contention (Proc. Am. Acad. **51:** 546. 1916) that *O. spicata* Rydb. is not even deserving of varietal rank. It is simply to be regarded as a form of *virgata*. Thanks to the help of Mr. W. T. Penfound, of the Alpine Laboratory on Pikes Peak, specimens have been examined that prove the existence of typical *virgata* from that region as well as the smooth-fruited form.

Series 3. HUMILAE. Nutlets distinctly and variously roughened on all surfaces. Scar open and triangular, margins sometimes elevated. Corolla tubes never longer than the calyces. Plants of Utah, Nevada, southwestern Idaho, and California. Species 14–19.

14. C. insolita (Macbr.) new comb. Plate 26, figs. 35–37.

Oreocarya insolita Macbr. Contr. Gray Herb. **48**: 28. 1916.

Biennial (or short lived perennial?) from a rather slender root; stems one to several, rather stout, erect, 1.5–4 dm. high, abundantly setose and rather coarsely strigose; leaves clustered at the base, spatulate, obtuse, 3–5 cm. long, dorsal surface subtomentose and rather sparsely appressed-setose and pustulate, ventral surface similar but setae smaller and fewer, pustules rather few and small, petioles abundantly long-hairy at the base, otherwise scarcely ciliate; inflorescence mostly confined to the upper ¼ or ½ of the stem, cymes rather few (for the genus) and conspicuously elongating, inflorescence abundantly but rather weakly setose, bracts inconspicuous; calyx densely hirsute, conspicuously setose with rather short weak bristles; sepals in anthesis linear-lanceolate, acute, about 4 mm. long, in fruit about 8 mm. long, exceeding the nutlets by about 4 mm.; corolla white, tube about 3 mm. long, equalling or somewhat shorter than the sepals, crests at the base of the tube well developed, fornices 0.5–1 mm. long, probably yellow, minutely papillose, slightly emarginate, limb about 7 mm. broad, lobes and tube subequal, lobes united for about ¼ their length; fruit broadly ovoid, 1–4 nutlets maturing, style exceeding the nutlets by 1–1.5 mm.; nutlets ovate, obtuse or acute, 4 mm. long, margins in contact or nearly so, acute, surfaces of nutlets dull or slightly glossy, the dorsal more or less carinate, tuberculate, granulo-muriculate and sometimes slightly rugose, ventral surface tuberculate and somewhat rugose, scar narrow but slightly open, the margin showing some tendency to be elevated.

Distribution: lower part of the Upper Sonoran Zone, southern Nevada. Type: Las Vegas, Nevada, May 4, 1905, *L. N. Goodding 2286*.

Specimens examined:

Nevada: Las Vegas, May 4, 1905, *Goodding 2286* (R.Mt., Minn., Mo., Gray, TYPE); Las Vegas, *K. Brandegee* (Calif.); Las Vegas, April 29, 1905, *Jones* (Pomona).

C. insolita is probably most closely related to *C. virginensis* and *C. tumulosa*. The differences between them, which it will be noticed are mostly those of habit rather than of nutlet peculiarities, may be summarized in the following way:

C. tumulosa	*C. insolita*	*C. virginensis*
Perennial.	Biennial.	Biennial.
Stems 1–2.5 dm. high.	Stems 1.5–4 dm. high.	Stems 1.5–4 dm. high.
Leaves setose below, with subappressed bristles.	Leaves inconspicuously setose below with appressed bristles.	Leaves conspicuously setose below with spreading bristles.
Inflorescence narrow, cymes short.	Inflorescence broad, cymes elongating, very numerous, flowers crowded.	Inflorescence broad, cymes elongating, few, and flowers rather distant.
Nutlets slightly carinate.	Nutlets distinctly carinate.	Nutlets distinctly carinate.
Dorsal surface with low indefinite tubercles.	Dorsal surface with short definite tubercles.	Dorsal surface with sharp definite tubercles.

In general appearance this species is very similar to *C. elata* of Grand Junction, Colorado. However, it is doubtful if the two species are closely related.

15. C. virginensis (Jones) new comb. Plate 27, figs. 38–40.

Krynitzkia glomerata var. *virginensis* Jones, Contr. West. Bot. **13:** 5. 1910.

Oreocarya virginensis (Jones) Macbr. Proc. Am. Acad. **51:** 547. 1916.

Biennial from a rather stout taproot; stems 1–many from the base, stout, 15–40 cm. high, conspicuously setose with divaricate bristles; leaves oblanceolate or spatulate, obtuse, 5–12 cm. long, rather sparsely setose, slightly hirsute and distinctly subtomentose on the dorsal surface, abundantly pustulate, ventral surface rather sparsely pustulate, weakly appressed-setose and subtomentose, at times subsericeous; inflorescence extending over ¾ or more of the stem, very floriferous, not interrupted, becoming a broad thyrsus in which the individual cymes are much elongated, densely setose, in age usually fulvous, lower foliar bracts often conspicuous and somewhat reflexed; calyx densely setose, sepals in anthesis lanceolate, about 4 mm. long, acute, in fruit linear,

10–12 mm. long, exceeding the nutlets by about 6 mm.; corolla white, tube 3–4 mm. long, equalling or slightly shorter than the sepals, crests at base of tube well developed, fornices conspicuous, probably yellow, nearly 1 mm. long, oblong, emarginate, conspicuously papillose, limb 6–8 mm. broad, lobes and tube subequal, lobes united for about ⅓ their length; fruit ovoid, 1–2 nutlets usually maturing, style exceeding nutlets by about 1 mm.; nutlets lance-ovate, obtuse, about 4.5 mm. long, margins in contact, acute, surfaces of nutlets somewhat glossy, the dorsal usually distinctly carinate, sharply tuberculate and somewhat rugose, surface between the tubercles uneven, ventral surface very uneven with indeterminate rugae and tubercles, scar narrowly triangular, some tendency evident to an elevated margin.

Distribution: lower part of Upper Sonoran Zone, southwestern Utah, southern Nevada, southeastern California. Type: La Verken, Utah, May 8, 1894, *M. E. Jones 5195a.*

Specimens examined:

Utah: Valley of the Virgin near St. George, 1874, *Parry 173* (Field, N.Y., Gray); Diamond Valley, May 16, 1902, *Goodding 830* (R.Mt., Pomona, Mo., U.S., Gray); Diamond Valley, April 28, 1894, *Jones 5125* (R.Mt., Pomona, Calif., Mo., U.S.); La Verken, May 8, 1894, *Jones 5195a* (Pomona, TYPE, R.Mt., Calif., Mo., U.S.).

Nevada: Muddy Valley, Lincoln Co., May 16, 1906, *Kennedy & Goodding 78* (Calif., Mo., U.S.); Vegas Valley, Lincoln Co., May 1, 1891, *Bailey, Coville & Funston 1888* (U.S.); Las Vegas, *K. Brandegee* (Pomona); Gold Mountain, 1898, *Purpus* (Calif.); Indian Spring, Charleston Mts., May 7, 1906, *Jones* (Pomona); Good Springs, April 30, 1905, *Jones* (Pomona); Tonopah, April 24, 1907, *Jones* (Pomona); Amargosa Desert, April 27, 1907, *Jones* (Pomona).

California: Panamint Canyon, May 4, 1897, *Jones 6728* (Pomona); above Barstow, April 18, 1921, *Jaeger 1113* (Pomona).

C. virginensis is in general appearance more like *C. thyrsiflora* than any other species of the genus. It is not likely to be confused with that species because of the great distance between their ranges. The nutlets of the two species are entirely different, and it seems quite doubtful if they are in reality closely

related. Its nearest relatives are probably *C. tumulosa*, *C. modesta*, and *C. insolita*. The distinguishing characteristics of these species are contrasted under *C. insolita*.

16. C. tumulosa (Payson) new comb. Plate 27, figs. 41–43.
Oreocarya tumulosa Payson, Univ. Wyo. Publ. Bot. **1**:164. 1926.
Long-lived caespitose perennial from a woody root; stems few to many from a branching caudex, rather stout, 10–25 cm. high, hirsute and densely setose with divaricate bristles; leaves numerous near the base, oblanceolate, obtuse, 3–5 cm. long, blade gradually narrowed into a long, slender, scarcely hirsute petiole, lower leaves conspicuously tomentulose, rather sparsely setose with weak, appressed bristles, dorsal surface slightly more pustulate than the ventral; inflorescence extending over ½ to ¾ of the stem, floriferous, rather narrow, uninterrupted, densely setose with yellowish bristles (at least in age), foliar bracts inconspicuous, reflexed; calyx densely divaricate or retrorse-setose, hirsute, sepals in anthesis linear-lanceolate, acute, about 4 mm. long, in fruit 8–10 mm. long, exceeding the nutlets by 4–6 mm.; corolla white, tube 3.5–4 mm. long, equalling or slightly shorter than the sepals, crests at the base of the tube evident but not conspicuous, fornices conspicuous, probably yellow, about 1 mm. long, limb 7 mm. broad, limb and tube subequal, lobes united for about ⅓ their length; fruit asymmetrical, 1–2 nutlets only maturing, style exceeding the nutlets by about 0.5 mm.; nutlet ovate-lanceolate in outline, obtuse, 4 mm. long, very pale in color, dull or slightly glossy, margins in contact, acute, dorsal surface of nutlets with a low but evident medial ridge, indefinitely tuberculate and sometimes indistinctly rugose, ventral surface roughened with indefinite tubercles and rugae, scar triangular, open, short, margin only slightly elevated.

Distribution: Upper Sonoran Zone on or near the Providence Mountains, San Bernardino Co., California. Type: Providence Mts., May, 1902, *T. S. Brandegee*.

Specimens examined:

California: Ivanpah Mts., San Bernardino Co., June 4, 1915, *Parish 10243* (Calif.); Providence Mts., May, 1902, *T. S. Brandegee* (Calif., TYPE); Providence Mts., May, 1892, *T. S. Brandegee*

(Phila.); Barnwell, May 14, 1911, *K. Brandegee* (Pomona, Calif.); vicinity of Bonanza King Mine, east slope of Providence Mts., May 21–24, 1920, *Munz, Johnston & Harwood 4209* (R.Mt., Pomona, Calif.).

This species has been confused with *C. humilis* and *C. nubigena*. The nutlets are quite different from either of those species. Its nearest relatives are probably *C. virginensis*, *C. insolita* and *C. modesta*. It is contrasted with the first two in the discussion of *C. insolita*. From *C. modesta* it differs in the lack of an elevated margin around the scar and by the indefinite roughening on the dorsal surface.

17. C. modesta new name. Plate 27, figs. 44–46.

Krynitzkia depressa Jones, Contr. West. Bot. **13:** 5. 1910, not *Cryptantha depressa* Nelson, Bot. Gaz. **34:** 29. 1902.

Oreocarya depressa (Jones) Macbr. Contr. Gray Herb. **48:** 32. 1916.

Densely caespitose, long-lived perennial from a woody root; stems few to many from the branching caudex which is densely clothed with the leaf-bases of former years, 8–15 cm. high, rather slender, setose with slender, weak bristles; leaves numerous on the crowns of the caudices, spatulate, obtuse, 1.5–4 cm. long, closely tomentose and setose with weak appressed bristles, pustulate on both surfaces, more abundantly on dorsal, petioles about as long as the blades, conspicuously ciliate near the base; inflorescence extending over ½ to ¾ of the stem, narrow, not interrupted, cymules not elongating, rather softly setose-hirsute, foliar bracts inconspicuous; sepals setose-hirsute, linear-lanceolate, acute, in anthesis 3–4 mm. long, in fruit 7–8 mm. long, exceeding the nutlets by 2–3 mm.; corolla white, tube 3–4 mm. long, equalling the sepals, crests at the base conspicuous, fornices probably yellow, rounded, nearly closing the throat, minutely papillose, 0.5–1 mm. long, limb 7–8 mm. broad, lobes equalling or exceeding the tube, united for about ⅓ their lengths; fruit ovoid, 2–3 nutlets usually maturing; nutlets broadly ovate, obtuse or acute, with slight tendency to be carinate, 3–4 mm. long, margins in contact, acute, surfaces of nutlets glossy, the dorsal tuberculate and often more or less rugose, tubercles and rugae (if present)

rounded and rather low, ventral surface deeply rugose and tuberculate, scar triangular, open, margin somewhat inclined to be elevated.

Distribution: Upper Sonoran Zone in southwestern Utah and eastern Nevada. Type: Aurum, Nevada, alt. 7,300 ft., June 20, 1893, *M. E. Jones 6692*.

Specimens examined:

Utah: hills east of Grass Valley, May 17, 1875, *Ward 49* (U.S., Gray); Modena, June 2, 1902, *Goodding 996* (R.Mt., Pomona, Mo., U.S., Gray).

Nevada: Aurum, June 20, 1893, *Jones 6692* (Pomona, TYPE, Mo., U.S.); Muncy, July 6, 1891, *Jones 6713* (Pomona).

This species is perhaps most closely related to *tumulosa*, *virginensis*, and *insolita*. In general appearance it is not unlike *tumulosa* or some of the varieties of *C. nana*.

18. C. humilis (Greene) new comb. Plate 27, figs. 47–49.

Eritrichium glomeratum var. (?) *fulvocanescens* Wats. Bot. King's Exp. 243. 1871.

E. glomeratum var. *humile* Gray, Proc. Am. Acad. **10**: 61. 1875, in part.

Oreocarya humilis Greene, Pittonia **3**: 112. 1896.

O. hispida Nelson & Kennedy, Proc. Biol. Soc. Wash. **19**: 156. 1906. (Type: "Collected in Carson Valley, Ormsby County, Nevada, April 24, 1904," No. *865*, *G. H. True*.)

O. echinoides Macbride, Contr. Gray Herb. **48**: 31. 1916, not *Krynitzkia echinoides* Jones.

O. Macbridii Brand, Fedde, Rep. Sp. Nov. **19**: 73. 1923. (Type: Mt. Jarbidge, Nevada, July 6, 1912, *Nelson & Macbride 1960*.)

Caespitose perennial; stems 1–several from the woody caudex, rather stout or slender, 10–30 cm. high, setose with rather weak bristles; leaves obovate-spatulate to oblanceolate, 3–8 cm. long, usually obtuse, rather weakly setose with appressed or slightly spreading bristles, the older leaves distinctly tomentose, petioles conspicuously ciliate near the base with long, white, weak hairs, pustules about equally numerous on both leaf-surfaces; inflorescence rather narrow, mostly continuous, extending over upper ½

or ⅔ of the stem, foliar bracts not conspicuous; calyx densely setose with rather slender bristles, sepals in anthesis linear or linear-lanceolate, acute, 4–5 mm. long, in fruit 8–13 mm. long, exceeding the nutlets by 5–8 mm.; corolla white, tube 4–5 mm. long, tube and calyx lobes subequal, crests at the base of the tube small but evident, fornices low (0.5 mm.), rounded, papillose, probably pale yellow, limb 8–10 mm. broad, lobes and tube subequal, lobes united for about ¼ their length; fruit lance-ovoid, all four nutlets commonly maturing, style exceeding the mature nutlets 1.5–2.5 mm.; nutlets ovate-lanceolate to lanceolate, acute or obtuse, 3–4.5 mm. long, margins in contact, acute or obtuse, surfaces of nutlets somewhat glossy, the dorsal often densely muricate, more or less tuberculate and usually rugose, ventral surface rather indistinctly muricate or tuberculate, scar open at the base or nearly closed, no elevated margin.

Distribution: mostly in mountainous parts of southwestern Idaho, Nevada, and northeastern California. Type not designated: "Frequent in the mountains of Nevada and adjacent eastern California: the Californian plant, as collected by Mr. Sonne, having nutlets nearly twice as large as in the more typical form of eastern Nevada, yet otherwise quite the same."

Specimens examined:

Idaho: Hot Hole, e. fork of Bruneau, July 3, 1912, *Nelson & Macbride* (R.Mt.).

Nevada: near Holborn, July 16, 1896, *Greene* (R.Mt., fragment, TYPE in Notre Dame Herb.); Palisade, June 12, 1903, *Stokes* (Calif.); Palisade, June 14, 1882, *Jones* (Pomona); Jarbidge, July 6, 1912, *Nelson & Macbride 1960* (R.Mt., Minn., Mo., U.S., Gray); Jarbidge, July 8, 1912, *Nelson & Macbride 1980* (R.Mt., Minn., Mo., U.S., Gray); Wadsworth, June 16, 1897, *Jones* (Pomona); Monitor Valley, July, 1868, *Watson 853*, in part (U.S., Gray); Coleman Valley, n.w. Nevada, July 29, 1896, *Coville & Leiberg 91* (U.S.); Carson City, May, 1882, *Jones 6732* (Pomona); Carson Valley, April 24, 1904, *True 865* (R.Mt.); Hunter Creek, Washoe Co., May 17, 1907, *Kennedy 1664* (Calif., Mo., U.S.).

California: sandy banks of Truckee River at Verdi, May and June, 1887, *Sonne* (Calif., Mo.); on Truckee River, Placer Co., July, 1886, *Sonne* (Calif.); Squaw Valley on Truckee River, June-

July, 1885–6, *Sonne* (Calif.); Mt. Stanford, Nevada Co., July, 1892, *Sonne* (Calif., Mo.); Susanville, June 28, 1897, *Jones* (Pomona); Castle Peak near the highest point, Nevada Co., Aug. 3, 1903, *Heller* (Phila., Mo., U.S., Gray); Sierra Co., 1874, *Lemmon 165* (Mo.); Castle Peak, 9,000 ft., Aug. 7, 1900, *Leiberg 5294* (U.S.); summit of Sierra Nevada, July 10, 1879, *Kellogg* (Calif.).

Thanks to Dr. J. A. Nieuwland, of Notre Dame University, I am in receipt of fragments from specimens labeled in Dr. Greene's handwriting as *Oreocarya humilis* Greene. No one of these is designated as the type but doubtless they serve to confirm our notion of Greene's concept of this species. Greene used a name proposed by Gray as a variety of *glomerata* and later transferred by him as the major part of *sericea*. *C. humilis*, as we now know it, was a small part of Gray's concept of the var. *humilis* of *glomerata*. However, it seems only reasonable to adopt the name for the species in the sense in which Greene used it. The specimens designated as *humilis* by Greene are as follows:

1. Near Holborn, Nevada, July 16, 1896, *Edw. L. Greene.*
2. Banks of Truckee River, near Verdi, California, April and May, 1889, *C. F. Sonne.*
3. Mt. near Truckee River, 8000 ft., July 18, 1886, *C. F. Sonne 77* (?).

It is always desirable to select a type specimen for every species whenever possible. In the present case the choice definitely falls upon the specimen collected by Dr. Greene near Holborn, Nevada. There are three reasons for this choice. First, Greene describes the nutlets as "rather densely tuberculate but not rugose." This is more characteristic of the specimen from eastern Nevada than of those from California. Second, Greene refers to the form from eastern Nevada as "the more typical form." Third, an author might be expected to select a plant of his own collecting as the center around which his concept is formed rather than one collected by another collector.

In eastern Nevada the boundary between this species and *nana* var. *commixta* seems rather weak. The rugae tend to be reduced to scarcely continuous tubercles or indistinct wrinkles. It was one of these forms that Macbride classified as *nana* var.

commixta. Brand, examining it more critically, noticed the rugae and thinking that it could not be placed in *commixta,* proposed a new species for it—*O. Macbridii.* An examination of a nutlet from Greene's plant from Holborn, Nevada, makes it evident that the elevations are two sizes. The smaller ones we call murications and the larger, tubercles. In neither are the rugae entirely absent. The specific limits between *humilis* and *nana* var. *commixta* are rather uncertain in the eastern Nevada region. It is unfortunate that this intermediate form should have been selected as the type rather than the more different forms from the Sierra Nevada. *Oreocarya Macbridii* is evidently an exact synonym of *C. humilis.*

19. C. caespitosa (A. Nels.) new comb. Plate 27, figs. 50–52.
Oreocarya caespitosa A. Nels. Erythea **7:** 65. 1899.

Densely caespitose, long-lived perennial; stems many from the ends of the numerous caudices, rather slender, 0.5–1 dm. high, weakly setose or hirsute; leaves mainly clustered on the caudices, spatulate to oblanceolate, obtuse or acute, 2–5 cm. long, densely strigose and appressed-setose with little-differentiated hairs, these so densely matted as to give an appearance similar to tomentum, pustules abundant on the lower surface, somewhat fewer above but quite evident in the older leaves; inflorescence narrow, confined to upper ½–¾ of the stem, foliar bracts inconspicuous; calyx subtomentose and shortly setose or hirsute, sepals linear to linear-lanceolate, acute, 3–4 mm. long in anthesis, in fruit 6–7 mm. long, exceeding the nutlets by about 3 mm.; corolla white, tube 3 mm. long, equalling or slightly shorter than the sepals, crests well developed at the base of the tube, fornices low (0.5 mm.), rounded, pale yellow, limb 5–6 mm. broad, tube and limb subequal or the tube slightly longer, corolla lobes united for ¼–⅓ their length; fruit lance-ovoid, less than four nutlets usually maturing (usually 2?), style scarcely, if at all, exceeding the nutlets; nutlets lanceolate, acute, 3–3.5 mm. long, margins in contact, obtuse or acute, surfaces of nutlets white, dull, the dorsal definitely rugose with low, rounded rugae, somewhat tuberculate, these larger elevations surrounded by numerous low, rounded muriculations, the ventral surfaces minutely and rather

indefinitely muriculate, scar extending from the base nearly to the apex, open and narrowly triangular, no elevated margin present.

Distribution: Upper Sonoran and lower part of the Transition Zones in southern Wyoming. Type (as designated in R.Mt. Herb.): Point of Rocks, *A. Nelson 4749*.

Specimens examined:

Wyoming: Rocky Mts., east side, *Nuttall* (Phila.); Cooper Creek, June 5, 1898, *E. Nelson 5448* (R.Mt.); Freezeout Hills, July 10, 1898, *E. Nelson 4497* (R.Mt.); T. B. Ranch, Carbon Co., June 20, 1901, *Goodding 60* (R.Mt.); Ft. Steele, May 25–June 10, 1901, *Tweedy 4260* (U.S.); Ft. Steele, June 16, 1900, *Nelson 7255* (R.Mt., Gray); Point of Rocks, June 15, 1898, *Nelson 4749* (R.Mt., TYPE, U.S.); Point of Rocks, June 19, 1901, *Merrill & Wilcox 617* (R.Mt., U.S., Gray); Red Desert, June 3, 1897, *Nelson 3120* (R.Mt.); Bush Ranch, Sweetwater Co., June 10, 1900, *Nelson 7078* (R.Mt., Pomona, Minn., Mo., U.S., Gray); n.e. corner of Sweetwater Co., July 6, 1926, *Nelson 10696* (R.Mt.); Bitter Creek, June 16, 1898, *Nelson 4772* (R.Mt., Mo., Gray); Green River, June 1, 1897, *Nelson 3072* (R.Mt.); Green River, June 23, 1896, *Jones 6726* (Pomona); red marl hills on Gros Ventre Fork, June 10, 1860, *Hayden* (Mo.); between Eden & Big Piney, July 6, 1922, *Payson & Payson 2578* (R.Mt., Pomona, Mo., Gray); between Opal and Kemmerer, June 19, 1923, *Payson & Armstrong 3223* (R.Mt., Mo., Gray); Fossil, June 12, 1898, *Nelson 4671* (R.Mt.); east of Evanston, June 28, 1922, *Osterhout 6248* (R.Mt.).

When Dr. Nelson first described this species he included in his specific concept specimens of the plant he later described as *Oreocarya cana*. The two are in reality very different in characters of pubescence and range. *C. caespitosa* is perhaps most closely related to *C. modesta* although it is perhaps not very far removed from *C. humilis*. Whatever its exact relationship *caespitosa* is a very definite unit with an isolated range and it is doubtful if any treatment, however large the specific concept, would fail to accord it full rank as a species.

Series 6. BRADBURIANAE. Nutlets always roughened dorsally and distinctly rugose or tuberculate, or both, and often muricate

also. Ventral surfaces smooth or variously roughened. Scar straight, closed or nearly so, margins not elevated. Corolla tubes never longer than the calyx lobes. Species 20–31.

20. C. thyrsiflora (Greene) new comb. Plate 27, figs. 53–55.
Eritrichium glomeratum var. *hispidissimum* Torr. Bot. Mex. Bound. Surv. 140. 1859, at least in part.

Oreocarya thyrsiflora Greene, Pittonia **3:** 111. 1896.

O. hispidissima (Torr.) Rydb. Bull. Torr. Bot. Club **33:** 150. 1906; Fl. Colo. 288. 1906.

O. urticacea Wooton & Standley, Contr. U. S. Nat. Herb. **16:** 166. 1913. (Type: Canyoncito, Santa Fe Co., New Mexico, June 18, 1897, *A. A. & E. G. Heller 3731*).

O. dura Nels. & Macbr. Bot. Gaz. **62:** 144. 1916. (Type: *E. L. Johnston 418*, 1907, Central Colorado).

O. monosperma Osterhout, Bull. Torr. Bot. Club **46:** 55. 1919. (Type: Trinidad, Las Animas Co., Colorado, July 20, 1918, *Osterhout 5754*).

Short-lived perennial (probably sometimes biennial); stems 1–several from the base, rather stout, 2–4 dm. high, densely setose; leaves oblanceolate, obtuse, 4–10 cm. long, densely and rather coarsely strigose, conspicuously pustulate on both leaf-surfaces, sometimes less densely so above, petioles conspicuously and coarsely setose-ciliate; inflorescence broad and round-topped, dense, abundantly setose, cymes much elongating, foliar bracts large but not conspicuous because of the width of the inflorescence; calyx densely setose, sepals in anthesis linear to lanceolate-linear, 3–4 mm. long, acute, in fruit 6–8 mm. long, exceeding the nutlets by about 4 mm.; corolla white, tube 3–4 mm. long, about as long as the sepals, crests at the base of the tube evident, usually well developed, fornices 0.5–1 mm. long, papillose, pale yellow, limb 7–8 mm. across, lobes and tube subequal, lobes united for about ⅓ their length, style exceeding the mature nutlets about 1.5 mm.; nutlets ovate-lanceolate, acute, about 3.5 mm. long, margins in contact, acute or obtuse, surfaces of nutlets somewhat glossy, the dorsal distinctly rugose, usually with a few tubercles, indefinitely and sparsely muriculate, or slightly roughened, scar straight, narrow,margin not elevated.

Distribution: Transition and Upper Sonoran Zones in western Nebraska, southeastern Wyoming, eastern slope of the mountains in Colorado and northern New Mexico. Type: "On the stony hills in southern Wyoming about Cheyenne, Laramie, etc., thence to middle Colorado," *Greene*.

Specimens examined:

Nebraska: War Bonnet Canyon, June, 1890, *Williams* (Mo.); Rush Creek, Deuel Co., July 2, 1891, *Rydberg 255* (Minn., U.S.).

Wyoming: Rocky Mts., Platte, *Nuttall* (Phila.); Pine Bluffs, June 27, 1889, *Bodin* (Minn.); Lower Pole Creek, July, 1856, *H. Engelmann* (Mo.); Guernsey, June 26, 1901, *Nelson 8263* (R.Mt.); Cheyenne, June 30, 1896, *Nelson 1990* (R.Mt., Minn.); 15 miles west of Cheyenne, Aug. 24, 1925, *Payson & Payson 4685* (R. Mt.); Chug Creek, Albany Co., June 29, 1900, *Nelson 7306* (R.Mt., Pomona, Minn., Mo., U.S., Gray); Table Mt., June 30, 1895, *Nelson 1362* (R.Mt.); Laramie, July 8, 1894, *Nelson 418* (R.Mt., U.S., Gray); Sheep Mt., Albany Co., Sept. 2, 1903, *Goodding 2076* (R.Mt., U.S.); Sheep Mt., June 24, 1924, *Payson & Payson 4246* (R.Mt.).

Colorado: Pawnee Buttes, July 8, 1919, *Osterhout 5934* (Gray); Pawnee Buttes, July 1, 1906, *Dodds 2077* (R.Mt.); Livermore, Larimer Co., June 3, 1897, *Osterhout* (R.Mt.); Livermore, July 26, 1913, *Osterhout 4979* (R.Mt.); near Florissant, Aug. 1–8, 1905, *Ramaley 1448* (R.Mt.); Bear Canyon, Colorado Springs, June 25, 1879, *Jones 972* (R.Mt., Pomona, Calif., U.S.); Colorado Springs, June 15, 1896, *Knowlton 35* (U.S.); Pikes Peak, July, 1920, *Johnston 2817* (Gray); Twin Lakes, July, 1873, *Wolf & Rothrock 700* (Phila., U.S.); Granite to Twin Lakes, Lake Co., Aug. 3, 1925, *Smith 3916* (R.Mt.); Granite, July 23, 1889, *Evermann* (U.S.); Canyon City, Sept. 26, 1874, *G. Engelmann* (Mo.); Canyon City, 1877, *Brandegee 4* (Mo.); Canyon City, June 27, 1896, *Osterhout 629* (R.Mt., Osterh.); near Salida, June 27, 1917, *Payson 1014* (R.Mt.); Salida, June 19, 1898, *Baker, Earle & Tracy 13* (R.Mt., Pomona, Minn., Mo., U.S., Gray); South Park, Aug. 3, 1884, *Letterman* (Field); Sangre de Cristo Creek, July 2, 1900, *Rydberg & Vreeland 5704* (R.Mt.); Buena Vista, July 6, 1892, *Sheldon 526* (U.S.); Buena Vista, Aug. 1–2, 1919, *Eggleston 15379* (Field); Trinidad, June 28, 1898, *Osterhout* (R. Mt.);

Trinidad, July 20, 1918, *Osterhout 5754* (R.Mt., Osterh., Gray); near Trinidad, June 17, 1911, *Standley 6036* (U.S.).

New Mexico: Canoncito, Santa Fe Co., June 18, 1897, *A. A. & E. G. Heller 3731* (Minn., Mo., U.S.); Glorieta, June, 1881, *Vasey* (R.Mt., Mo., U.S.); Sierra Grande, Union Co., June 18, 1911, *Standley 6056* (U.S.).

Early collections of this species were very generally referred to *C. Bradburiana*. This was probably due in large part to the fact that the two are rarely found growing together. In southeastern Wyoming where the ranges do overlap and they are seen growing together it is at once evident that they are distinct specifically. The broad inflorescence of *thyrsiflora* is the outstanding distinction of the species, but in addition the flowers of *thyrsiflora* are smaller and the blooming season later than in *Bradburiana*. The author was at one time inclined to refer certain Montana plants with a broad open inflorescence to this species. Later, however, it has seemed evident that they are forms of *C. Bradburiana* or of *C. Sheldonii*.

A careful examination of the type of *Oreocarya dura* makes it quite certain that it is an immature specimen of *C. thyrsiflora*.

21. C. elata (Eastw.) new comb. Plate 28, figs. 56–58.

Oreocarya elata Eastw. Bull. Torr. Bot. Club **30**: 241. 1903.

Perennial, probably short-lived; stem rather stout, one to several, 3–5 dm. high, rather sparsely and loosely strigose as well as hirsute-setose; radical leaves clustered at the base, spatulate, 1.5–3 cm. long, blade often rather abruptly narrowed to the petiole, acute or obtuse, rather coarsely strigose, densely pustulate and appressed-setose on dorsal surface, ventral surface strigose and pustulate, petioles densely covered with long white hairs; cauline leaves linear-oblanceolate, acute, 2–4 cm. long, setae more widely spreading; inflorescence extending over upper ⅓ or ½ the length of the stem, upper cymes elongating, the lower remaining short, the inflorescence then with a tendency to have a broad top, much narrower downwards, abundantly setose with rather weak slender bristles, bracts inconspicuous; calyx abundantly setose with rather weak bristles, sepals in anthesis lanceolate, acute, about 4 mm. long, in fruit about 8 mm. long, ex-

ceeding the nutlets by 2–3 mm.; corolla white, tube about 4 mm. long, equalling the sepals, crests at the base of the tube well developed, fornices nearly 1 mm. high, distinctly papillose, probably yellow, limb about 9 mm. broad, lobes and tube subequal, lobes united for about ⅓ their length; fruit lance-ovoid, all four nutlets usually maturing, style exceeding the nutlets 1–2 mm.; nutlets ovate-lanceolate, acute or obtuse, about 5 mm. long, margins acute, in contact, surfaces of nutlets slightly glossy, the dorsal margined, densely tuberculate and more or less rugose, entire surface minutely and densely papillose, ventral surface similar but less evidently rugose, scar straight, closed, extending from near the base almost to the apex, slightly open and forked at the base, no elevated margin present.

Distribution: Upper Sonoran Zone, near Grand Junction, Colorado. Type: "Collected by the author [*Eastwood*] near Grand Junction, Colorado, on the road to the coal mines, growing on the bare clay hills characteristic of the region, flowering May 15, fruiting June 28, 1892."

Specimens examined:

Colorado: Grand Junction, May 15, 1892, *Eastwood* (N.Y., U.S., Gray); Grand Junction, June 10, 1920, *Osterhout 5996* (R.Mt., Gray, Osterh.).

Although still imperfectly known, there can be no doubt but that this species is very distinct and quite worthy of specific rank. In habital characteristics it resembles *C. insolita* very closely. The nutlet characters of the two species are so different, however, that one doubts any very close relationship between the two. Excellent but immature specimens of the type collection are in the National Herbarium and in the Gray Herbarium.

22. C. sericea (Gray) new comb.

Perennial from a tap root; stems 1–many from the base, 1.5–4.5 dm. high, rather sparsely setose with slender, divaricate bristles; leaves somewhat clustered at the base, spatulate to oblanceolate, usually obtuse, 2.5–10 cm. long, dorsal surface densely strigose and appressed-setose, abundantly pustulate, ventral surface densely and uniformly silky-strigose, rarely, if at all, pustulate; inflorescence extending over ⅔ to ¾ the length

of the stem, in flower narrow, somewhat glomerate, abundantly setose, foliar bracts conspicuous, especially in the young inflorescence; calyx setose, sepals in anthesis linear-lanceolate, acute, 3–4 mm. long, in fruit 7–9 mm. long, exceeding the nutlets by 3–5 mm.; corolla white, tube 2.5–3.5 mm. long, slightly shorter than the sepals, crests at the base of the tube evident or conspicuous, fornices small (about 0.5 mm. high), rounded, papillose, probably always pale yellow, limb 6–8 mm. broad, lobes and tube subequal, lobes united for about ⅓ their length; fruit ovoid or lance-ovoid, 3–4 nutlets commonly maturing, style exceeding the mature nutlets by 0.25–1 mm.; nutlets lanceolate, acute, 2.75–3.5 mm. long, margins in contact, acute, surfaces of nutlets dull, the dorsal sparsely tuberculate and somewhat rugose as well as more or less muriculate, ventral surfaces at least somewhat roughened, usually distinctly muriculate, scar straight, closed or nearly so, extending from near the base to near the apex, no elevated margin present.

Distribution: Upper Sonoran Zone, southern and southwestern Wyoming, northern Colorado, northeastern Utah.

The varieties of *C. sericea* may be distinguished as follows:

Inflorescence becoming rather broad in age due to the elongation of the cymules; leaves oblanceolate; nutlets 3–3.5 mm. long.....*37a.* var. *typica*
Inflorescence usually narrow, even in age; leaves narrowly oblanceolate; nutlets 2.75–3 mm. long.....*37b.* var. *perennis*

22a. Var. **typica** n. var. Plate 28, figs. 59–61.

Eritrichium glomeratum var. *humile* Gray, Proc. Am. Acad. **10:** 61. 1875, in large part.

Krynitzkia sericea Gray, Proc. Am. Acad. **20:** 279. 1885, in part.

Oreocarya sericea Greene, Pittonia **1:** 58. 1887.

O. argentea Rydb. Bull. Torr. Bot. Club **31:** 637. 1904. (Type: Rifle, Garfield Co., Colo., 1900, *Osterhout 2122*).

O. procera Osterhout, Bull. Torr. Bot. Club **47:** 211. 1920. (Type: Glenwood Springs, Garfield Co., Colorado, June 18, 1899, *Osterhout 1867*).

Stems usually stout, 1.5–4 dm. high; leaves rather broadly oblanceolate, obtuse, 4–10 cm. long; inflorescence becoming rather broad in fruit due to the partial elongation of the cymules; sepals

about 7 mm. long in fruit, exceeding the nutlets by 3–4 mm.; corolla tube about 3 mm. long, limb 6–8 mm. broad; fruit ovoid; nutlets rather broadly lanceolate, 3–3.5 mm. long, rather inconspicuously margined, style scarcely exceeding the mature nutlets, dorsal surface of the nutlets sparsely tuberculate, distinctly rugose and more or less muriculate, ventral surface sparsely muriculate, scar closed or nearly closed, straight.

Distribution: southern Wyoming, northwestern Colorado, and northeastern Utah. Type: Bridger's Pass (Wyoming), 1856, *Henry Engelmann*.

Specimens examined:

Wyoming: Elk Mt., July 1, 1899, *Little & Stanton 179* (Mo.); Bridger Pass, 1856, *H. Engelmann* (Gray, TYPE, Mo.); Pass Creek to Bridger's Pass, 1859, *H. Engelmann* (N. Y., Gray); 11 miles north of Encampment, July 2, 1922, *Payson & Payson 2528* (R.Mt., Pomona, Field, Mo., Gray).

Colorado: Hayden, Routt Co., July 10, 1913, *Osterhout 4940* (R.Mt., Osterh.); Kremmling, Grand Co., June 22, 1907, *Osterhout 3476* (R.Mt., Osterh.); Rifle, June 23, 1900, *Osterhout 2122* (Pomona, N. Y.); Middle Park, July 26, 1876, *Patterson* (Field); Glenwood Springs, June 8, 1920, *Osterhout 5960* (R.Mt., U.S., Gray, Osterh.); Glenwood Springs, June 29, 1895, *Osterhout* (R.Mt.); Grand Junction, May 30, 1921, *Osterhout 6094* (Osterh.).

Utah: Mill Fork, July 7, 1894, *Jones 5607a* (Pomona, Calif., U.S.).

22b. Var. **perennis** (A. Nels.) new comb.

Oreocarya affinis perennis A. Nels. Erythea **7**: 67. 1899.

O. perennis Rydb. Bull. Torr. Bot. Club **33**: 150. 1906.

Stems rather slender, 1.5–4 dm. high; leaves narrowly oblanceolate, acute or obtuse, 2.5–4.5 cm. long; inflorescence narrow and glomerate even in fruit, cymules scarcely elongating; sepals about 7 mm. long in fruit, exceeding the nutlets by 3.4 mm.; corolla white with pale yellow fornices, tube 2.5 mm. long, limb about 6 mm. broad; fruit lance-ovoid; nutlets narrowly lanceolate, not wing-margined, 2.75–3 mm. long, dorsal surface sparsely tuberculate, more or less rugose, somewhat muriculate, ventral surface rather sparsely muriculate, scar straight, closed.

Distribution: Upper Sonoran Zone, southwestern Wyoming. Type: Green River, Wyoming, May 31, 1897, *A. Nelson 3035*.

Specimens examined:

Wyoming: between Eden and Big Piney, July 6, 1922, *Payson & Payson 2580* (R.Mt., Pomona, Field, Mo., Gray, Colo.); Green River, June 25, 1895, *Shear 4381* (U.S.); Green River, June 23, 1896, *Jones* (Pomona); Green River, June 14, 1898, *Nelson 4715* (R.Mt., TYPE, Mo., Gray); Green River, May 30, 1897, *Nelson 3035* (R.Mt., U.S.); 21 miles west of Green River, June 19, 1923, *Payson & Armstrong 3206* (R.Mt., Mo., Gray); between Opal and Kemmerer, June 19, 1923, *Payson & Armstrong 3224* (R.Mt., Mo.); Ft. Bridger, July, 1873, *Porter* (Herbarium not recorded); Evanston, July, 1869, *Watson 852* (U.S.).

The name *sericea* has always been a stumbling block in the way of any satisfactory treatment of this group of plants. At the time when it was described (1885) only seven other species had been proposed in this section. These were among the most outstanding units in the genus and it is evident that *sericea*, whatever it was, was different from any of these and so must be retained as a valid species. Because of this necessity all botanists, to treat these plants for the region assigned to *sericea*, had to make some disposition of it. These interpretations have been extremely varied, and herbarium material labeled "*sericea*" has added to the confusion. During the course of the present study it became probable that *sericea*, when it was located, would almost certainly replace some more recently proposed name, since most of the distinguishable forms were treated under recent names and there was left no place for *sericea*—which was a name older than these others.

The problem was evidently to be solved by a careful study of the specimens available to Dr. Gray when he proposed the species and a consideration of the evidence gathered from the published description. The author believes he has reached a satisfactory solution of the problem by following out these lines of research and proposes to restrict the name *sericea* to the plant that has recently been treated as *Oreocarya argentea* Rydb. The evidence on which this conclusion is based is presented in detail in the following paragraphs.

First of all it is useful to summarize the criteria that have governed the case in question.

1. It is necessary to select a type specimen on which to attach the name in the final analysis, since it is evident that more than one species was involved in Dr. Gray's concept. It must be borne in mind that it is rather unfair to force a type specimen concept on work that was done before this method was emphasized as it is at present. In case it can not be shown that Dr. Gray had one plant especially in mind when he described *sericea* then it might be better to discard the name altogether.

2. The type specimen, if one is to be located, must be selected from the material Dr. Gray had at hand when he described *sericea*. Since he based this species in large part, "magna parte," on his earlier variety *humile*, it would seem only reasonable to select the type from specimens which he had previously considered as representing that variety.

3. The type should be represented by a mature and adequate specimen in which the nutlets are developed since these were described and are of the greatest importance in determining the species of this genus.

4. The description of *sericea* as given by Gray should be examined very carefully and the characters emphasized there should belong to the type specimen. These may be summarized as follows: *sericea* is said to differ from *glomerata* in being less hispid and in being perennial rather than annual. It is a many-stemmed plant. The indument is soft, strigose-sericeous, and the setae are short, not very rigid and often appressed. The nutlets are subrugose-tuberculate and oblong-ovate.

5. The range of the species *sericea* is given as follows: "Alpine or subalpine, on mountains from Colorado and Utah to Oregon and Montana and probably in the British Possessions. There are less canescent forms from the Saskatchewan region and also from the higher Sierra Nevada (and uncertain as to the duration of the root) which may belong either to this species or to dwarfed forms of the foregoing." It would seem that Dr. Gray thought of the forms from Saskatchewan, the British Possessions, or from the higher Sierra Nevada as aberrant. The type then should come from some point in the range "alpine or subalpine, on

mountains from Colorado and Utah to Oregon and Montana."

6. Dr. Gray says, "I have adopted one of the two specific names under which this species occurs in Nuttall's collections." Nuttall's specimen should be examined and its identity considered in connection with the specimens and description of *sericea* as given by Gray.

The next point of attack is to examined the herbarium material considered by Dr. Gray as representing his new species. There are in the Gray Herbarium three sheets that bear the notation "*Krynitzkia sericea* Gray" in Dr. Gray's own handwriting. These sheets also bear the designation "Ed. 2. Syn. Fl. N. Amer." Each of these sheets bears several specimens. This material may be described as follows:

Sheet 1 contains 4 specimens:

a. Bridger's Pass, 1856, *H. Engelmann* = *O. argentea* Rydb.

b. W. side of Wasatch Mts., 1844, *Frémont* = *O. humilis* Greene, *K. depressa* Jones, or some form of *O. nana* Eastwood. Too immature for certain identification.

c. Clover Mts., Nevada, 1868, *Watson 853* = *O. humilis* Greene, *K. depressa* Jones, or some form of *O. nana* Eastwood. Too immature for certain identification.

d. Mountain Hot Springs, Yellowstone Park, 1885, *Tweedy 816* = *C. Bradburiana.*

Sheet 2 contains 3 specimens:

a. Montana Terr. 1867 = *C. Bradburiana.*
It also bears the two separate notations in Dr. Gray's handwriting "*E. glomeratum*" and "Probably dwarf *K. glomerata.*"

b. Summit, California, 1871, *Bolander* = *humilis* or possibly *nubigena.* Specimens immature.

c. Grass Valley, Utah, 1875, *Ward 49* = *depressa.*

Sheet 3 contains 2 specimens at the present time and probably 5 (including fragments) in Dr. Gray's time:

a. Shinberger's Canyon, S. Montana, 1880, *Watson 287* = *Sheldonii.* Specimen immature but identification practically certain.

b. A specimen of *Bradburiana* without data. A note by Dr. Gray says "origin uncertain."

c. Pine Creek, Baker Co., Oregon, 1879, *Cusick*. This is not now on this sheet but the piece on which it is mounted fits the remains of sheet 3, and evidently it was attached to sheet 3 in Dr. Gray's time. This is *nubigena*.

d. Another fragment has been located that was probably attached to sheet no. 3. This fragment contains 2 fragmentary specimens and a note in Dr. Gray's handwriting: "Two more dwarf and very sericeous-canescent forms in Herb. Acad. Philad. Nuttall." One of the fragmentary specimens is evidently a bit of the plant we now know as *caespitosa*. It is from a specimen collected by Nuttall.

e. The second specimen on the scrap described above is an immature piece of the plant we now know as *cana* and was collected at Scott's Bluff on May 30, 1858.

If we now list the specimens that may be considered to compete as the type of *sericea* we see that the following species are represented: *argentea*, *humilis*, *depressa*, *nana*, *Bradburiana*, *nubigena*, *Sheldonii*, *caespitosa*, and *cana*. Five of these can be discarded at once. *Bradburiana* must not be considered, since Dr. Gray was separating his species from that and gave good differences between the two, while *nana* must be discarded because no specimen is represented that is mature enough to make identification certain. The species *humilis* can be eliminated because it is represented by no mature specimen and because the specimens from the higher Sierra Nevada were considered aberrant. *Sheldonii* is represented by a single specimen in which the nutlets are quite immature, and *caespitosa* is represented by fragments so scanty that they are only recognizable by association with a better specimen in the herbarium of the Philadelphia Academy. It carries a manuscript name given it by Nuttall which was never published and which is not *sericea*. We now have left for consideration the species *argentea*, *depressa*, *nubigena*, and *cana*.

Earlier in this discussion it was suggested that since Gray's *sericea* was based in large part upon his variety *humile* it would be reasonable to select a type that had been included in his variety when it was published in 1875. If we now examine the specimens of the remaining species we find that the mature specimen of *nubigena*, and the only certain one of that species, was collected in 1879, after the variety was published. We also find that the only certain representative of *depressa* was collected in 1875, the year of the publication of the variety, and so was evidently not at hand when the variety was described since the papers by Dr.

Gray containing this description were presented to the Academy "May 12 and Oct. 13, 1874." We find Dr. Gray's notation "*E. glomeratum, humile*" on only two specimens of the series that has been described. These are on the one from Bridger's Pass (*argentea*) and on the immature one from the "W. side of the Wasatch Mts." This serves to confirm the selection of *argentea* as the center around which Dr. Gray built his variety *humile* and species *sericea*. We have left, however, two species that need further consideration—*argentea* and *cana*—since *nubigena* and *depressa* are eliminated because they did not form a part of Gray's variety *humile*.

The only reason for considering *cana* as a competitor for the name of the species in question is because Dr. Gray said he chose a name under which the species occurs in Nuttall's collections. The plant to which Nuttall gave the manuscript name of *sericea* was undoubtedly the plant we now know as *cana*. Dr. Gray believed this plant to be part of his species *sericea*, but it is evident he did not describe it or have it particularly in mind. He said *sericea* was the same as his var. *humile* in large part. He did not consider Nuttall's *sericea* as typical var. *humile*, as is shown by his comment, "Nuttall collected and gave MSS. names to some very dwarf and silky canescent forms, which appear to belong here." These aberrant forms, we now know as *caespitosa* and *cana*. The description of Gray's *sericea* does not fit *cana*. The pubescence in *cana* is practically uniform and the setae would not have been described "short, not very rigid and often appressed." The nutlets were unknown to Dr. Gray, and if they had been known would not have been described as "subrugose-tuberculate." The range given by Gray for *sericea* is scarcely large enough to include *cana*. Scott's Bluffs, from where he had a specimen of *cana*, is in Nebraska and so hardly to be described as "alpine and subalpine."

By a process of elimination we obtain a type specimen for *sericea* and select a specimen from Bridger's Pass, collected by H. Engelmann, to represent the species in the final analysis. This selection, however, need not be made on a basis of elimination, since the specimen under consideration has many points that argue for its being the plant that Dr. Gray had especially in

mind when the species was described. Since the matter is of so much importance it may be well to recapitulate briefly the reasons why the specimen from Bridger's Pass is held as the type of *sericea*.

1. Of the 8 species that are probably represented on the sheets that Gray had at hand when he described *sericea* there is no numerical preponderance of any one species. The species *argentea* is represented by one specimen and another sheet was undoubtedly present and considered as *sericea*, but in this case the writing was not in Dr. Gray's hand and so was not considered in the search for the type.

2. The specimen of *argentea* is the best one of the series and shows mature fruits as well as flowers.

3. The published description of *sericea* fits the specimen that has been selected as the type.

4. The specimen under consideration formed part of Gray's concept of the variety *humile*, and the species *sericea* is, he says, the same as that, in large part.

5. The range given by Dr. Gray includes the locality in which the specimen by Engelmann was collected.

6. No other species included in Gray's *sericea* has so good a claim to be considered the typical form as does the plant that has been known as *Oreocarya argentea*.

It seems to have been generally assumed that Bridger's Pass is in Montana, and so the effort has been made to search for typical *sericea* in that state. The Bridger's Pass of Henry Engelmann was surely in southern Wyoming, west of the Platte River. This is near the northern limit of the range of *O. argentea* Rydb.

It is possible that further collections of *O. procera* Osterhout and of Jones' plant from Utah may prove them worthy of varietal rank. The author so designated them at one time.

C. sericea, as now understood, is chiefly distinguished by the lack of pustulate hairs on the upper leaf surface and the consequent sericeous appearance of the indument. Dr. Rydberg evidently had quite an erroneous idea of the variety *perennis* when he reported it from North Dakota and Idaho in his flora of the Rocky Mountains.

23. C. aperta (Eastw.) new comb. Plate 28, figs. 62–64.

Oreocarya aperta Eastw. Bull. Torr. Bot. Club **30**: 241. 1903.

Perennial, caudex branched from a woody root; stems several, rather slender, 1–2 dm. high; leaves densely clustered at base and the dilated petioles imbricated, pubescence of upper and lower leaf surfaces similar, sparsely strigose and abundantly pustulate-setose, bristles conspicuous, spreading; radical leaves spatulate to oblanceolate, 3 cm. long, 8 mm. wide; cauline leaves oblanceolate, about as long as the radical leaves but narrower; inflorescence branched from near the base with many spreading, simple or 2-forked spikes, those of all the stems aggregated into a closely branched thyrsus, spikes peduncled, longer than the subtending leaves, pedicels very short, about 0.5 mm. long; calyx densely setose, sepals in anthesis linear or linear-lanceolate, acute, about 3 mm. long, in fruit 8–10 mm. long, exceeding the nutlets about 5 mm.; corolla white, tube 2.5–3 mm. long, equalling or somewhat shorter than the sepals, crests at the base of the tube evident, fornices conspicuously papillose, probably yellow, nearly 1 mm. long, limb about 6 mm. broad, tube and limb subequal, the lobes united for about ¼ their length; fruit ovoid, all four nutlets commonly maturing, style exceeding the nutlets by about 2 mm.; nutlets lanceolate, acute, 2.5–3 mm. long, margins in contact, acute, surfaces of nutlets somewhat glossy, the dorsal tuberculate, more or less rugose and somewhat muriculate, ventral surface irregularly and ambiguously roughened, scar extending from near the base to near the apex, straight, closed, no elevated margin present.

Distribution: Upper Sonoran Zone, Grand Junction, Colorado, June 27, 1892, *Eastwood.*

Specimen examined:

Colorado: Grand Junction, May 17, 1892, *Eastwood* (Calif.).

C. aperta is another species of this genus of which more material is badly needed. Presumably it is distinct from all others but it is so imperfectly known that it is impossible to know to what other species to ally it.

24. C. rugulosa (Payson) new comb. Plate 28, figs. 65–67.

Oreocarya rugulosa Payson, Univ. Wyo. Publ. Bot. **1**: 166. 1926.

Short-lived perennial; stems few to many, unbranched above the base, rather slender, 15–30 cm. high, rather sparsely but conspicuously setose; leaves narrowly oblanceolate or spatulate, obtuse, 2–4 cm. long, strigose-canescent and setose, pustulate hairs abundant on both surfaces, slightly more numerous on dorsal, petioles ciliate with long, rather weak white hairs; inflorescence mostly confined to the upper ¼ or ½ of the stem, cymes elongating, foliar bracts inconspicuous, inflorescence densely setose with long, white, slender hairs; calyx subtomentose and abundantly setose, sepals in anthesis lanceolate, acute, 4 mm. long, in fruit linear-lanceolate, 7–8 mm. long, exceeding the nutlets by about 5 mm.; corolla white, tube 3–4 mm. long, equalling the sepals in anthesis, crests at the base of the tube well developed and conspicuous, fornices nearly closing the throat, well developed, not over 0.5 mm. long, distinctly papillose, probably yellow, limb about 6 mm. broad, tube and limb subequal, lobes united for ⅓ their length; fruit ovoid, all four nutlets usually maturing, style exceeding the mature nutlets 1–1.5 mm.; nutlets lanceolate, subacute, 3 mm. long, margins in contact, acute, surfaces of nutlets somewhat glossy, the dorsal distinctly rugose with rather distant, low rugae, somewhat tuberculate also, ventral surface only slightly uneven, scar straight, extending from near the base almost to the apex, closed above, slightly open near the base, no elevated margin present.

Distribution: Upper Sonoran Zone, western Utah. Type: Fish Springs, Utah, *M. E. Jones*.

Specimen examined:

Utah: Fish Springs, June 4, 1891, *Jones* (R.Mt., TYPE, Pomona, Calif.).

The most outstanding characteristic of this plant is the smooth inner surfaces of the nutlets. It is to be considered a member of the *spiculifera-interrupta-Sheldonii* group of species.

25. C. interrupta (Greene) new comb. Plate 28, figs. 68–70.

Oreocarya interrupta Greene, Pittonia **3:** 111. 1896.

Long-lived, caespitose perennial; stems few to many from the branching caudex, rather slender, 3–9 dm. high, rather sparsely strigose and setose with slender white trichomes; radical leaves

tufted on the caudices, oblanceolate, obtuse or acute, 3–5 cm. long, the blade tapering gradually to a hispid-ciliate petiole, lower leaf-surfaces rather densely strigose or subtomentose, setose with subappressed and rather inconspicuous bristles, pustulate, upper surfaces more finely strigose and very inconspicuously setose, pustules minute; stem-leaves similar, reduced and narrower upwards; inflorescence densely setose with white hairs, more or less interrupted, narrow cymes somewhat elongating at the top, stems bearing cymes for ½–⅔ of their length; calyx setose, sepals in anthesis about 3 mm. long, linear or linear-lanceolate, in fruit 6–8 mm. long, exceeding the nutlets by 4–5 mm.; corolla white, tube 3 mm. long, equalling the sepals in anthesis, crests at the base of the tube well developed, fornices probably pale yellow, low, scarcely papillose, limb 5–7 mm. broad, tube and limb subequal or the tube slightly longer, lobes united for ⅓ their length; fruit lanceolate-ovoid, 1–4 nutlets maturing, style exceeding the mature nutlets by less than 1 mm.; nutlets lanceolate, obtuse or subacute, 3 mm. long, margins in contact or nearly so, acute, surfaces of nutlets dull or slightly glossy, the dorsal definitely tuberculate with small tubercles, a few of these elongated on some nutlets, but the nutlets only rarely rugose, indefinitely muriculate, especially toward the apex and the margins, ventral surfaces similar but with fewer tubercles and muriculations, scar straight, extending from near the base to near the apex, closed or nearly so, margin not elevated.

Distribution: Upper Sonoran Zone in northeastern Nevada. Type: "in open woods some miles east of Wells," *Greene*.

Specimens examined:

Nevada: Park's Station, 25 miles north of Elko, Aug. 4, 1913, *Hitchcock 1005* (U.S.); Elko, Aug. 2, 1913, *Hitchcock 929* (U.S.); Humboldt Wells, Elko Co., July 28, 1908, *Heller 9185* (Mo., N.Y., U.S., Phila.).

This plant is imperfectly known but is apparently most closely related to *C. spiculifera*. From that species it differs in the less conspicuously setose, broader radical leaves, the tuberculate and not rugose nutlets, and the shorter style. It has not been possible to locate the type but specimens from near the type locality agree very well with the original description and there is probably no

doubt but that the species has been correctly identified. No specimens have been seen that were so high as the plants described by Greene. He says "1½ to 3 feet high." The specimens at hand are all about one foot high.

26. C. spiculifera (Piper) new comb. Plate 28, figs. 71–73.

Oreocarya spiculifera Piper, Contr. U. S. Nat. Herb. **11:** 481. 1906.

O. cilio-hirsuta Nels. & Macbr. Bot. Gaz. **55:** 378. 1913. (Type: *Nelson & Macbride 1799*, Minidoka, Idaho, June 23, 1912.)

Long-lived, caespitose perennial; stems few to many from the base, slender, 15–30 cm. high, strigose, hirsute and setose with long slender white hairs; leaves linear-oblanceolate or linear-spatulate, acute or obtuse, 3–7 cm. long, dorsal surface densely strigose and with rather numerous pustulate, spreading setae, ventral surface densely strigose, sparsely setose with somewhat weaker and more closely appressed pustulate hairs, petioles conspicuously long-ciliate; inflorescence on the upper ½ or ¾ of the stem, densely setose with long, white, slender hairs, cymules somewhat elongating, foliar bracts mostly inconspicuous; calyx strigose and densely setose, sepals in anthesis 4–5 mm. long, linear-lanceolate, in fruit 8–10 mm. long, exceeding the nutlets by 6–7 mm.; corolla white, tube 3–4 mm. long, equalling the sepals in anthesis, crests at the base of the tube evident, fornices well developed, at least 0.5 mm. high, scarcely papillose, pale yellow, limb about 7 mm. broad, tube and limb subequal or the tube slightly longer, lobes united for ¼ their length; fruit ovoid, all four nutlets usually maturing, style exceeding the mature nutlets by about 2 mm.; nutlets lanceolate, acute, 3–4 mm. long, margins usually in contact or nearly so, acute or obtuse, surfaces of nutlets dull, the dorsal definitely but narrowly margined, densely muriculate, rugose and sparsely tuberculate, ventral surfaces densely muriculate, sparsely tuberculate and with a few short rugae, scar straight, extending from near the base to near the apex, narrowly open, no elevated margin present.

Distribution: Upper Sonoran Zone of western Washington and south-central Idaho. Type: "collected at Ritzville, Adams County, by *Sandberg & Leiberg* (*No. 164*), June 6, 1893."

Specimens examined:

Idaho: Salmon, June 23, 1920, *Payson & Payson 1768* (R.Mt., Mo., Gray); Arco, June 19, 1893, *Palmer 189* (U.S.); Challis, July 15, 1916, *Macbride & Payson 3223* (R.Mt., Gray); Martin, July 5, 1916, *Macbride & Payson 3039* (R.Mt., Mo., U.S., Gray); Minidoka, June 23, 1912, *Nelson & Macbride 1799* (R. Mt., Mo., U.S., Gray); Shoshone, May 27, 1899, *Saunders 4875* (Mo.); Boise-Payette Project, June 2, 1911, *Macbride 875* (Pomona, R. Mt., Minn., Field, Mo., U.S., Gray); New Plymouth, May 21, 1910, *Macbride 93* (R.Mt.); Weiser, April 26, 1900, *Jones 6673* (Pomona).

Washington: Wilson Creek, eastern Washington, June, 1893, *Sandberg & Leiberg* (Pomona, Minn.); Ritzville, June 6, 1893, *Sandberg & Leiberg 164* (Wash., Calif., Mo., U.S., TYPE, Gray).

C. spiculifera is a fairly well-defined unit characterized by narrow radical leaves with conspicuously setose petioles. The caudex is multicipital and the leaves are very numerous in typical forms. It is likely to be confused with *C. Macounii*, and at one time the author was inclined to unite the two as varieties under one specific name. This process of submergence would lead to such wholesale reductions, however—*Sheldonii, Macounii, spiculifera, interrupta, rugulosa, Bradburiana, sobolifera*—that it seemed unwise. *C. spiculifera* has some contact, too, with *C. nana* var. *Shantzii*. A specimen from southeastern Idaho was examined that looked remarkably like *spiculifera* but the nutlets were uniformly muricate as in the var. *Shantzii*. This intermediate plant might, of course, have been a hybrid.

27. C. celosioides (Eastw.) new comb. Plate 28, figs. 74–76.

Oreocarya celosioides Eastw. Bull. Torr. Bot. Club **30:** 240. 1903.

Long-lived perennial from a stout, woody root; stems 1–several from a leafy caudex which is densely clothed with the broad imbricated petioles of former leaves, stout, 2–4 dm. high, densely setose with stiff divaricate bristles; leaves clustered at the base of the stem—or only the petioles of former leaves remaining to show the basal tuft—spatulate to oblanceolate, usually obtuse, 2–5 cm. long, densely setose with spreading white bristles and

subtomentose, densely pustulate on both surfaces, petioles conspicuously ciliate; inflorescence extending over upper ½ to ⅔ of stem, becoming rather broad due to the elongation of the cymules, densely setose, foliar bracts inconspicuous; calyx densely setose with spreading bristles, sepals in anthesis about 5 mm. long, linear-lanceolate, acute in fruit, about 12 mm. long, exceeding the nutlets by about 8 mm.; corolla white, tube 4–5 mm. long, about as long as the sepals, crests at the base of the tube well-developed, conspicuous, fornices nearly 1 mm. high, probably yellow, slightly papillose, limb about 8 mm. across, lobes and tube subequal, lobes united for ¼ to ⅓ their length; fruit ovoid, 2–4 nutlets maturing, style exceeding the mature nutlets by 2.5–3 mm.; nutlets 4–5 mm. long, ovate-lanceolate, acute, margins acute, almost winged, in contact, surfaces of nutlets dull or slightly glossy, the dorsal conspicuously rugose toward the middle and muriculate toward the edge, somewhat tuberculate also, in the type collection slightly keeled, the ventral surfaces rugose or tuberculate and somewhat muriculate, scar straight, closed, extending from near the base to near the apex, margin not elevated.

Distribution: Upper Sonoran Zone along the Columbia River in Washington and in the drainage of the John Day River in Oregon. Type: "*Thos. J. Howell*, from the banks of the Columbia River, eastern Washington, July, 1881."

Specimens examined:

Washington: Washington Terr. 1883, *Brandegee 996* (Calif., Gray); Klickitat Hills, May, 1888, *Howell 431* (Wash., Calif.); banks of Columbia River, July, 1881, *Howell* (Calif.); Rock Island, Kittitas Co., July 12, 1893, *Sandberg & Leiberg 440* (Wash., Calif., Minn., U.S., Gray); near Columbus, June 10, 1886, *Suksdorf 888* (Calif., Field, Mo., U.S., Gray); Wenatchee, 1895, *Whited* (Wash.); Wenatchee, May 28, 1899, *Whited 1099* (Wash., U.S., Gray).

Oregon: Dalles, May, 1882, *Howell* (Phila.); Mitchell, Aug. 1, 1917, *Lawrence 1030* (U.S.); near Fossil, Gilliam Co., May 29, 1894, *Leiberg 125* (U.S.); Canyon City, July, 1902, *Griffiths & Hunter 170* (U.S.); dry hills near Fossil, Wheeler Co., June 2, 1925, *Henderson 5212* (Mo., Gray); Kimberly, Grant Co., June

24, 1925, *Henderson 5212* (Mo., Gray); dry slope, Clarno, southeast Wasco Co., July 3, 1921, *Peck 10020* (N.Y.).

I would limit this plant to the Upper Sonoran Zone of central Washington and Oregon. This is in essential agreement with Piper in his 'Flora of Washington' except that he includes one plant (*Cotton 359* from the Rattlesnake Hills) which I refer, rather dubiously, to *C. Macounii*. He says that *celosioides* comes from the "Arid Transition" Zone but according to the map of life zones in his 'Flora,' the localities in which *celosioides* are found are all in the Upper Sonoran Zone. The large nutlets and stout stems are the best characters of *celosioides* that may be used to separate it from its nearest allies—*C. Sheldonii* and *C. spiculifera*.

28. C. Sheldonii (Brand) new comb. Plate 28, figs. 77–79.

Oreocarya sericea Piper, Contr. U.S. Nat. Herb. **11:** 482. 1906, not *Krynitzkia sericea* Gray.

O. celosioides Macbr. Contr. Gray Herb. **48:** 29. 1916, in part, as to specimens cited, not *O. celosioides* Eastw.

O. glomerata Standley, Contr. U. S. Nat. Herb. **22:** 401. 1921, not *Cynoglossum glomeratum* Pursh.

O. Sheldonii Brand, Fedde, Rep. Sp. Nov. **19:** 73. 1923.

Definitely perennial, rather loosely caespitose; stem rather stout, 2–3 cm. high, abundantly setose with rather slender, divaricate hairs; basal leaves numerous, spatulate to oblanceolate, usually obtuse, 2–4 cm. long, 5–8 mm. broad, abundantly setose with rather weak subappressed hairs, the older leaves distinctly tomentose, pustules present on both leaf surfaces; cauline leaves similar, reduced upwards; inflorescence setose, rather narrow or the branches elongating in age, mainly uninterrupted, extending over ½ to ¾ of the stem, foliar bracts inconspicuous; calyx densely setose, sepals in anthesis linear-lanceolate, acute, 3–5 mm. long, in fruit about 8 mm. long, exceeding the nutlets by 4–5 mm.; corolla white, tube 4 mm. long, subequal to the sepals in anthesis, crests at the base of the tube evident, fornices 0.5 mm. high, probably yellow, papillose, limb 5–10 mm. broad, limb and tube subequal or the tube slightly longer than the limb, lobes united for about ⅓ their length; fruit ovoid or lanceolate-ovoid, all four nutlets commonly maturing, style exceeding the

nutlets by about 2 mm.; nutlets lanceolate, acute or subacute, 3–4 mm. long, margins in contact, acute, surfaces of nutlets slightly glossy, the dorsal tuberculate, usually more or less rugose and obscurely muricate, ventral surface more or less tuberculate; scar straight, extending from near the base to near the apex, closed, no elevated margin present.

Distribution: Transition Zone of western Montana, northern Idaho, eastern Washington, and northeastern Oregon. Type: Deep Creek, Wallowa Co., Oregon, *Sheldon 8315*.

Specimens examined:

Montana: St. Mary Lake, Glacier Nat'l. Park, Aug. 8, 1919, *Standley 17423* (U.S.); Glacier Park Station, July 6, 1919, *Standley 15107* (U.S.); Glacier Park Station, Aug. 15, 1919, *Standley 17594* (U.S.); Great Falls, June 16, 1891, *Williams 109* (Minn., U.S.); Helena, 1891, *E. N. Brandegee* (Calif.); Hallett's Ranch, Aug. 14, 1892, *E. N. Brandegee 17* (Calif.); Helena, June & July, 1892, *Aiton 64* (Minn.); Deer Lodge Valley, July 19, 1905, *Jones* (Pomona); Missoula, June 10, 1922, *Kirkwood 1262* (Mont.); near Missoula, June 12, 1901, *MacDougal 169*, this specimen is intermediate to No. 31 (*C. Bradburiana*) (U.S., Mont., Gray); upland benches, Hamilton, June 16, 1906, *Blankinship 734* (Field, U.S., Mont.); on Madison River, 4300 ft., June 28, 1860, *Hayden* (Mo.); 10 miles east of Monida, June 18, 1899, *A. & E. Nelson 5429* (R.Mt., Mo.); Shinberger's Canyon, southern Montana, July 15, 1880, *Watson 287* (Gray).

Idaho: Kootenai Co., July, 1880, *Sandberg* (Minn.); in the Palouse country and about Lake Coeur d'Alene, June–July, 1892, *Aiton 31* (Minn.).

Washington: Spokane, May 16, 1896, *Piper 2294* (Wash., Gray); Hangman Creek, Spokane, May 23, 1897, *Piper* (Wash.); Spokane River, June 2, 1892, *Henderson 2563* (Wash., Gray); Spokane, June 19, 1913, *Turesson* (R.Mt.); between mouth of Spokane and Colville, 1838–42, *Wilkes 437* (*61*), (Phila.).

Oregon: Deep Creek, Wallowa Co., June 16, 1897, *Sheldon 8315* (N.Y., Mo., U.S.).

This species as here defined is composed of rather different individuals from a large range. Mature specimens are still rather few, and the specific limits are sometimes difficult of location.

The plant is obviously a relative of *C. Bradburiana* in spite of Brand's suggestion that it is closely related to *leucophaea*. From *Bradburiana* it is separated because of the perennial, caespitose base and the western range. Macbride confused it, in part, with *celosioides*. From that species *Sheldonii* may be distinguished by the smaller, differently marked nutlets, the more slender stems, and the more easterly range. It is also likely to be confused at times with *spiculifera*. That plant has narrower leaves that are strongly ciliate-hirsute, a stronger tendency to a multicipital caudex, somewhat different nutlets, and a more southern and eastern range. *C. Macounii* is the other perennial relative of *C. Bradburiana*. That plant is characterized by narrow, strongly setose leaves, while *Sheldonii* has broad, tomentose ones. The range of *Macounii* is more northern than the others. Piper recognized the species as distinct from *celosioides* (and *glomerata*, of course) but supposed it to be *sericea*. To this Macbride makes an interesting comment, "Piper may be justified in distinguishing two species here, but if the material from eastern Washington [*Sheldonii*] represents a species distinct from that of the Columbia Valley [*celosioides*], it cannot bear the name *O. sericea* which must be used to designate a very different plant of the Rocky Mountains." With *sericea* now identified with Rydberg's *argentea*, Macbride's comment is particularly pertinent.

29. C. Macounii (Eastw.) new comb. Plate 29, figs. 80–82.

Eritrichium glomeratum Macoun, Cat. Canad. Pl. **1:** 337–338. 1883, in part.

Oreocarya Macounii Eastw. Bull. Torr. Bot. Club **40:** 480. 1913.

Caespitose, long-lived perennial from a rather slender tap-root; stems slender, 10–20 cm. high, conspicuously setose with divaricate bristles; leaves linear to linear-oblanceolate, 2–5 cm. long, acute or obtuse, conspicuously setose with spreading bristles (particularly on the petioles), leaf-surfaces strigose, more densely pustulate below than above; inflorescence narrow, mainly limited to upper ⅓ or ½ of the stem, densely setose, foliar bracts sometimes rather conspicuous near the base of the inflorescence; calyx densely setose as well as strigose, sepals linear-lanceolate,

acute, about 3 mm. long in anthesis, in fruit 6–7 mm. long, exceeding the nutlets 3–4 mm.; corolla white, tube about 3 mm. long, equalling the sepals, crests at the base of the tube evident but not conspicuous, fornices about 0.5 mm. high, probably yellow, limb 7–9 mm. broad, tube and limb subequal, lobes united for about ⅓ their length; fruit lanceolate-ovoid, all four nutlets commonly maturing, style exceeding the nutlets 1.5–2 mm.; nutlets lanceolate, acute or subacute, 2.5–3 mm. long, margins in contact, acute, surfaces of nutlets dull or slightly glossy, the dorsal rather indeterminately rugose, tuberculate and muriculate, the ventral surfaces indeterminately muriculate and tuberculate, scarcely rugose, scar extending from the base to near the apex, straight, closed except for a very small area at the base, margin not elevated.

Distribution: rocky hills, from southern Saskatchewan, Alberta, and British Columbia into Montana, Wyoming, and Washington. Type: Moose Mountain Creek, Saskatchewan, *John Macoun.*

Specimens examined:

Saskatchewan: Saskatchewan, 1858, *Bourgeau* (Gray); Carlton House, 1827 (?), *Drummond* (Gray); Cypress Hills, June 8, 1884, *Macoun 85007* (Canada); Moose Jaw, June 14, 1903, *Barber 325* (Gray); Moose Jaw, July 7, 1880, *Macoun* (Minn.); Chaplin, June 18, 1896, *Macoun 12800* (Pomona, Field, Canada); Moose Mt. Creek, July 6, 1880, *Macoun* (N.Y., TYPE, U.S.); Wood Mt., June 5, 1895, *Macoun 11819* (Canada); Spy Hill, July 1, 1906, *Macoun 78500* (Canada); Parkby, June 10, 1905, *Palmer* (U.S.); South Saskatchewan, Aug. 14, 1872, *Macoun 17089* (Canada); File Hills, July 2, 1879, *Macoun 17089* (Canada).

Alberta: Medicine Hat, May 31, 1894, *Macoun 5801* (Canada, Gray); Macleod, May 12, 1913, *Moodie* (U.S.); Old Man's River, June 20, 1881, *Dawson 17088* (Canada); Milk River, July 13, 1895, *Macoun 11820* (Pomona, Canada).

British Columbia: Similkamen River, June 8, 1905, *Macoun 76741*[1] (Wash., Field, Canada).

Montana: Baltic, May 30, 1900, *Wilcox 79* (U.S.); Browning,

[1] This specimen is not a typical *C. Macounii* but is intermediate to *C. Sheldonii.*

Sept. 10, 1909, *Jones*[1] (Pomona); Lewis & Clark Nat'l. Forest on Beaver Creek, Aug. 6, 1912, *Saunders*[1] (U.S.); near Helena, June, 1921, *Wooton*[1] (U.S.); Helena, June, 1893, *Starz*[1] (Mo.); Helena, 1886, *Kelsey 102*[1] (Pomona); Helena, June, 1888, *Kelsey*[1] (U.S.); plains about Helena, June, 1887, *Anderson*[1] (Calif., Mo.); Midvale, June 24, 1903, *Umbach 149*[1] (U.S.); Garrison, July 10, 1909, *Jones*[1] (Pomona); Armstead, June 20, 1920, *Payson & Payson 1746*[2] (R.Mt., Mo., Gray).

Wyoming: between Sheridan and Buffalo, June 15–July 15, 1900, *Tweedy 3570* (R.Mt.); West Hurlbut Creek, Big Horn Mts., June 15, 1909, *Willits 92* (R.Mt.).

Washington: north side Rattlesnake Mts., May 11, 1901, *Cotton 359*[1] (R.Mt., Wash., Mo., Phila., U.S., Gray).

C. Macounii, although readily distinguishable in its extreme form as it is found on the Canadian plains, has rather doubtful specific limits in the south where it comes in contact with the ranges of related species. It is likely to be confused with *C. spiculifera*, but the author believes that it is in reality more closely related to *C. Bradburiana* and *C. Sheldonii*. It is certain, however, that all four species are too close for entire convenience and all may be found to merge. Its right to specific recognition rests on its narrow leaves, abundant and conspicuous setae, and small, rather ambiguously marked nutlets.

30. C. sobolifera Payson[3] Plate 29, figs. 83–85.

Long-lived multicipital perennial; stems branching from the

[1] These specimens are not typical *C. Macounii*. They are from a unified area in western Montana and are distinctly aberrant. In some ways they are intermediate between *Macounii* and *Sheldonii*, in others they are more like *C. Bradburiana*. Further study may make it seem desirable to separate them varietally from *Macounii* on the basis of a more robust habit.

[2] This is not a typical *C. Macounii*, but is intermediate to *C. Sheldonii*.

[3] **Cryptantha sobolifera** sp. nov., perennis; caulibus sterilibus prostratis ad apicem foliatis, caulibus floriferis 15–18 cm. altis hirsutis et setosis; foliis obovato-spathulatis obtusis 1.5–3.5 cm. longis dense strigosis aut subtomentosis et insigniter setoso-hirsutis supra et subter pustulosis, basis in petiolas gracilibus gradatim attenuatis; thyrsis angustis longo-setosis; sepalis lineari-lanceolatis 3.5 mm. longis, fructiferis 6–8 mm. longis quam nuculis 4 mm. longioribus; corolla alba, tubo 3–4 mm. longo, calycem non superante, limbo 7 mm. lato; stylo nuculas 1.5–2 mm. superante; nuculis non nitidis ovato-lanceolatis subacutis 3 mm. longis, facie exteriore tuberculosa aut leviter rugosa, faciebus ventralibus fere laevibus, sulco angusto recto, margine non edita.—Collected by *M. E. Jones*, Upper Marias Pass, Montana, Sept. 10, 1909 (Pomona, TYPE).

root and apparently more or less prostrate or creeping, some of them sterile and terminating in a cluster of leaves (soboles), fertile stems 15–18 cm. high, hirsute and strigose; leaves clustered on the ends of the sterile branches and scattered on the stem, obovate-spatulate, obtuse, 1.5–3.5 cm. long, gradually narrowed to a slender petiole, dorsal and ventral surfaces similar, densely strigose or subtomentose and conspicuously setose-hirsute with long, slender, white bristles, both surfaces pustulate, petioles densely setose-ciliate; inflorescence on the upper ⅓ or ½ of the stem, cymules slightly elongating, foliar bracts inconspicuous, inflorescence densely long-setose; calyx strigose as well as setose, sepals in anthesis 3.5 mm. long, linear-lanceolate, in fruit 6–8 mm. long, exceeding the nutlets by about 4 mm.; corolla white, tube 3–4 mm. long, equalling the sepals in anthesis, crests at the base of the tube forming a united ring, conspicuous, fornices nearly 1 mm. long, yellow, emarginate, papillose, limb about 7 mm. broad, tube and limb subequal, lobes united for ⅓–½ their length; fruit ovoid, all four nutlets commonly maturing, style exceeding the mature nutlets by 1.5–2 mm.; nutlets ovate-lanceolate, subacute, 3 mm. long, margins in contact, acute, surfaces of nutlets dull, the dorsal rather sparsely tuberculate, sometimes more or less rugose, indistinctly muricate, the ventral nearly smooth or with a few indefinite tubercles, scar straight, extending from near the base to near the apex, closed, margins not elevated.

Distribution: Canadian Zone, northwestern Montana. Type: Upper Marias Pass, Montana, *M. E. Jones.*

Specimens examined:

Montana: Cottonwood Creek, Central Montana, July 30, 1896, *Flodman 748* (N.Y.); Upper Marias Pass, 6,000 ft. alt., Sept. 10, 1909, *Jones* (Pomona, TYPE).

It is with much hesitation that the author describes new species in the *Bradburiana* group. The specimens cited for this species are so aberrant, however, that it has been impossible to assign them to any known species. It is very probable that further collections in the mountains of Montana will show this plant to be an important and distinct unit of this perplexing alliance. The curious development of sterile, creeping stems or soboles

indicates a habitat on loose earth or gravel slides. The label on the type collection bears the statement, "Upper Temperate Life Zone." This is defined by Jones as the spruce belt. The plant is evidently one of the very few members of the genus that inhabits a subarctic region.

31. C. Bradburiana Payson new name. Plate 29, figs. 86–88.

Cynoglossum glomeratum Pursh, Fl. Am. Sept. **2**: 729. 1814, not *Cryptantha glomerata* Lehm.

Myosotis glomerata (Pursh) Nutt. Fl. Am. Sept. **2**: 729. 1814.

Rochelia glomerata (Pursh) Torr. Ann. Lyc. N. Y. **2**: 226. 1828.

Eritrichium glomeratum (Pursh) DC. Prodr. **10**: 131. 1846.

Krynitzkia glomerata (Pursh) Gray, Proc. Am. Acad. **20**: 279. 1885.

Oreocarya glomerata (Pursh) Greene, Pittonia **1**: 58. 1887.

O. affinis Greene, Pittonia **3**: 110. 1896 (Type: "sandy hills near Red Buttes, Wyoming, 5 July, 1896," *Greene*), not *Cryptantha affinis* (Gray) Greene.

Krynitzkia pustulata Blankinship, Montana Agr. Coll. Sci. Studies, Bot. **1**: 96. 1905, not *Cryptantha pustulosa* (Rydb.) Payson.

Oreocarya perennis Rydb. Fl. Rocky Mountains, 722. 1917, in part, not *O. affinis perennis* A. Nels.

Biennial, or short-lived perennial (?) from a tap root; stems rather stout, simple or branched from the base, if branched from the base then one stem usually exceeding the others, stems 1.5–3.5 dm. high, coarsely setose with divaricate bristles; leaves forming a rosette at the base the first year, radical leaves spatulate to oblanceolate or the outermost almost obovate, obtuse, 2–5 cm. long, cauline leaves somewhat narrower and longer, pubescence similar on both leaf surfaces, setose with spreading bristles and subtomentose, abundantly pustulate; inflorescence rather narrow, somewhat glomerate, extending over upper ⅔ or ¾ of the stem, foliar bracts near the base of the inflorescence conspicuous and longer than the cymules in the young inflorescence; calyx densely setose and hirsute, sepals linear-lanceolate, acute, in anthesis about 4 mm. long, in fruit 8–10 mm. long, exceeding the nutlets about 5 mm.; corolla white, tube 3–4 mm.

long, equalling the sepals, crests at the base of the tube conspicuous and well developed, fornices low, rounded or emarginate, about 0.5 mm. long, papillose, pale yellow, limb about 10 mm. broad, lobes and tube subequal or the lobes slightly longer than the tube, lobes united for about ⅓ their length; fruit ovoid, all four nutlets usually maturing; style exceeding the mature nutlets by about 1.5 mm.; nutlets dull or slightly glossy, margins acute, in contact, the dorsal surface of nutlets more or less rugose-tuberculate and with at least a few muriculations, ventral surface indefinitely tuberculate or rugose and somewhat muriculate, scar straight, closed, extending from near the base to near the apex, no elevated margin present.

Distribution: Upper Sonoran and Transition Zones, southern Alberta, North Dakota, western South Dakota and Nebraska, Montana, Wyoming, and northeastern Colorado. Type: "in Upper Louisiana," *Bradbury*. Bradbury collected this plant at the Big Bend of the Missouri in what is now South Dakota.

Specimens examined:

Alberta: Lethbridge, June 5, 1894, *Macoun 5802* (Mo., Canada, Gray).

North Dakota: Pembina, *Havard* (U.S.); Minot, June 5, 1908, *Lunell* (U.S.); Glen Ullin, June, 1891, *Holzinger 6* (U.S.); Medora, July 17, 1891, *Waldron* (R.Mt.); N. W. Territory, *Nicollet 374* (Phila.); Marmarth, June 15, 1914, *Moyer 453* (Minn.).

South Dakota: bluffs of Missouri River, Walworth Co., June 15, 1909, *Moyer* (Minn.); Missouri Valley near Ft. Pierre, June 25, 1839, *Geyer* (U.S.); Ft. Meade, June 9, 1887, *Forwood 272* (U.S.); "Louisiana," *Bradbury* (Phila.); Interior, Stanley Co., June 5, 1914, *Over 5188* (U.S.); White River, Washington Co., Aug. 5, 1914, *Over 6185* (U.S.); Date, Perkins Co., June 1, 1912, *Visher 587* (R.Mt.); Short Pines, Harding Co., June 9, 1911, *Visher 431* (R.Mt.); Cone Hills, Harding Co., July 8, 1920, *Over* (U.S.); Crook, July 23, 1910, *Visher 295* (R.Mt.); 8 miles north of Belle Fourche, Butte Co., June 11, 1916, *Eggleston 12520* (U.S.); Belle Fourche River, June 2, 1894, *Bailey 14* (U.S.); Piedmont, June, 1895, *Pratt* (R.Mt., Minn.); Rockerville, Black Hills, June 15–30, 1909, *White* (Mo.); Hot Springs, June 13, 1892, *Rydberg 893* (U.S.).

Nebraska: Lavaea, July 14, 1898, *Bates* (R.Mt.); Hay Springs, June 6–7, 1901, *MacDougal 60* (Mont.); Ft. Robinson, July, 1891, *Bates* (Minn.); Belmont, July 24, 1889, *Webber* (Mo.); Warbonnet Canyon, *Williams* (U.S.).

Montana: Custer, May 16, 1890, *Blankinship* (R.Mt., Mo.); Livingston, June 8, 1906, *Blankinship 372a* (Pomona, Mo.); Wreck Creek, Sweet Grass Co., June 15–19, 1912, *Eggleston 7959* (U.S.); Greycliff, Sweet Grass Co., May 15–31, 1912, *Eggleston 7838* (U.S.); Livingston, June 7, 1901, *Scheuber* (Minn., U.S.); Bozeman, May 19, 1900, *Moore* (Calif.); Bozeman, June 16, 1905, *Blankinship 373* (U.S.); Sedan, June 11, 1901, *Jones* (R.Mt.); mouth of Shield's River, June 6, 1883, *Scribner 174* (Phila., Gray); near Jefferson City, June 27, 1883, *Scribner 174* (U.S.); Park Co., 1889, *Tweedy* (U.S.); near Pony, July 8, 1897, *Rydberg & Bessey 4882*[1] (R.Mt., Wash., Minn., U.S., Mont., Gray); Spanish Basin, Gallatin Co., June 23, 1897, *Rydberg & Bessey 4883*[1] (R.Mt., Wash., Minn., U.S., Gray); Park Co., 1889, *Tweedy* (U.S.).

Wyoming: Cruse Creek, Sheridan Co., July 6, 1909, *Willits 236* (R.Mt.); hills east of Sheridan, June 17, 1912, *Sharp 132* (R.Mt.); between Sheridan and Buffalo, June 15–July 15, 1900, *Tweedy 3569* (R.Mt.); south of Buffalo, July 24, 1926, *Nelson 10741* (R.Mt.); 40 miles west of Cody, Aug. 31, 1922, *von Schrenk* (Mo.); Mammoth Hot Springs, June, 1887, *Tweedy 816* (Field, U.S.); Cheyenne River, *Williams* (R.Mt., Gray); Wind River, July 14, 1881–82, *Forwood* (U.S.); head of Middle Fork of Powder River, July 18, 1901, *Goodding 287* (Pomona, R.Mt., U.S., Gray); well on Salt Creek Road, Natrona Co., July 9, 1901, *Goodding 230* (R.Mt., Mo., U.S., Gray); Birds Eye, June 24, 1910, *Nelson 9355* (R.Mt., Minn., Gray); Birds Eye, June 20, 1910, *Nelson 9411* (R. Mt., Minn., Gray); Hartville, June 30, 1901, *Nelson 8319* (Pomona, R.Mt., Mo.); Uva, July 10, 1894, *Nelson 388* (Pomona, R.Mt., Minn., Mo., U.S., Gray); Chug Creek, Albany Co., July, 1900, *Nelson* (R.Mt.); Laramie Hills, June 16, 1894, *Nelson 255* (U.S., Gray); Sheep Mt., Albany Co., June 24, 1925, *Payson & Payson 4247* (R.Mt.); Laramie

[1] *Rydberg & Bessey 4882 and 4883* are not typical *C. Bradburiana* but are intermediate to *C. Sheldonii*.

Hills, June 18, 1896, *Nelson 1956* (Pomona, R.Mt., Minn., Mo.); Rock River, June 18, 1901, *Goodding 29* (Pomona, R.Mt., Field, U.S., Gray); Red Buttes, June 18, 1891, *Buffum 640* (R.Mt.); Sand Creek, Albany Co., May 31, 1900, *Nelson 6961* (Pomona, R.Mt., Mo., U.S.); Ft. Steele, June 16, 1907, *Nelson 9045* (R.Mt., Minn., Mo., Gray); Ft. Steele, June 18, 1898, *Nelson 4837* (R.Mt.); Ft. Steele, June 16, 1900, *Nelson 7248* (Pomona, R.Mt., Minn., U.S., Gray); Ft. Steele, May 25–June 10, 1901, *Tweedy 4261* (U.S., Gray); Tipton, June 17, 1898, *Nelson 4788* (R.Mt.); near Table Rock in Red Desert, July 5, 1926, *Nelson 10700* (R.Mt.).

Colorado: Pawnee Buttes, July 8, 1920, *Osterhout 5927* (R.Mt., U.S., Gray, Osterh.).

C. Bradburiana was the first species of this genus to be described and probably also the first species to find its way into herbaria. This was due very largely to its wide distribution in an accessible part of the western United States. Because of the priority of this species and the homogeneous nature of the genus as a whole, very many specimens have been determined as *glomerata* (i.e., *Bradburiana*) that are in reality quite different plants. A number of varieties of this species have been described from time to time that are equally far removed from *glomerata* as it is here understood. Indeed the plants most closely related have been described in recent years and have been proposed and maintained as species since their introduction into scientific literature.

The specific concept of *Bradburiana* and its allies that has been adopted in the present paper is too small for entire satisfaction. With a more inclusive concept the following units would be recognized as varieties only: *sobolifera*, *celosioides*, *Macounii*, *interrupta*, *spiculifera*, *Sheldonii*, and possibly *rugulosa*. This reduction of specific units is not accomplished in the present paper for a number of reasons. In the first place the smaller units are mostly satisfactory in the sense that the intermediates are few and the geographical ranges isolated and consistent. In the second place the binomials are somewhat more convenient and the segregates have been previously maintained by other authors as species. In the third place if aggregation proceeded to the point indicated above, there would be good reason to extend the

specific boundaries further and include *humilis*, *sericea*, and *aperta*. From that it would be only a step to include *nana* and its allies, and so the one species would come to contain a large proportion of the units in the genus. In other words, by maintaining a smaller specific concept than is entirely satisfactory, the various units in the genus are kept more nearly uniform in degree of difference from one another and when one commences to aggregate species, it is difficult to stop and the result is not satisfactory because the species retained are of such very different values.

The greatest difficulty comes in delimiting *Bradburiana*, *Sheldonii*,and *Macounii*. In western Montana these forms are very perplexing and much work yet remains to be done before an entirely satisfactory solution can be reached. *Sheldonii* is distinctly and conspicuously perennial and caespitose, while *Bradburiana* is typically biennial and solitary. The comparatively few intermediates that have come to hand have been cited with the species they seemed most to resemble. *Macounii* is distinctly perennial but has very narrow leaves. This is in great contrast with *Sheldonii* but in a few cases it has been difficult to place a particular plant in one species or the other. Only one segregate of *Bradburiana*, in the limited sense, has ever been proposed, namely, *O. affinis* Greene. The present author can see no reason for maintaining this. Macbride (Contr. Gray Herb. **48:** 30. 1916) quotes Dr. Nelson concerning the validity of *affinis* over *glomerata* (i.e., *Bradburiana*). It has become evident that Nelson was contrasting *C. Bradburiana* and *C. thyrsiflora* and so the differences given do not relate to the present question. From Macbride's correspondence, which is at hand, it is certain that he maintained *affinis* almost entirely on Nelson's judgment.

It is unfortunate to have to substitute an unfamiliar name for a familiar one but since *Cryptantha glomerata* Lehm., which is a valid South American species and the type of the genus *Cryptantha*, was described long ago, there remains no other alternative if *Oreocarya* is merged in *Cryptantha*.

The name is given in honor of the first collector of the species, who, it seems, fared rather badly in the matter of scientific recognition for his many hardships and privations.

Series 4. NANAE. Nutlets conspicuously muricate, in some species also somewhat rugose. Scar with at least a tendency to be open and so triangular at the base. Species 32–38.

32. C. nana (Eastw.) new comb.
Oreocarya nana Eastw. Bull. Torr. Bot. Club **30**: 243. 1903.
Perennial, more or less densely caespitose; stems 1–many from a branching caudex, rather slender, 5–25 cm. high; leaves spatulate to oblanceolate, usually obtuse, 1–5 cm. long, ventral surface more or less pustulate but somewhat less abundantly so than the dorsal surface; inflorescence usually rather narrow, cymules usually not elongating, foliar bracts not conspicuous; sepals in anthesis linear to linear-lanceolate, acute, 3.5–5 mm. long, in fruit 7–10 mm. long, exceeding the nutlets by 3–4 mm.; corolla white, tube about 3 mm. long, usually distinctly shorter than the calyx lobes in anthesis, crests at base of tube conspicuous or nearly obsolete, fornices low (less than 1 mm.), rounded, more or less papillose, probably yellow, limb 7–10 mm. broad, lobes united for nearly ⅓ their length; fruit lance-ovoid to ovoid, 1–4 nutlets maturing, margins regularly in contact, acute or obtuse; nutlets lanceolate to ovate-lanceolate, acute, dorsal, and usually the ventral surfaces also, densely and uniformly muriculate, not rugose nor tuberculate, scar slightly open at least, and so more or less triangular, no elevated margin evident.

Distribution: Upper Sonoran Zone of western Colorado, southeastern Idaho, Utah, and eastern and southern Nevada.

The varieties of *C. nana* may be distinguished as follows:

Stems 15–25 cm. high; leaves rather sparsely subtomentose and setose; styles 0.5–1 mm. longer than the mature nutlets; central and western Utah and eastern Nevada ..... *32a.* var. *commixta*
Stems 10–20 cm. high; leaves densely tomentose and appressed-setose; styles scarcely exceeding the mature nutlets; north-central Utah and southeastern Idaho ..... *32b.* var. *Shantzii*
Stems 10–15 cm. high; leaves densely tomentose and appressed-setose; calyx very densely setose and tomentose; styles exceeding the mature nutlets by 0.5–1 mm.; south-central Utah to southeastern Nevada ..... *32c.* var. *ovina*
Stems 5–12 cm. high; leaves coarsely strigose and setose; calyx densely setose but scarcely tomentose; styles not exceeding the mature nutlets; western Colorado to northeastern Utah ..... *32d.* var. *typica*

32a. Var. **commixta** (Macbride) new comb.
Oreocarya commixta Macbride, Contr. Gray Herb. **48**: 33. 1916.

Perennial; stems 15–25 cm. high; leaves spatulate, obtuse, 3–5 cm. long, setose with subappressed or spreading bristles, strigose or subtomentose; inflorescence rather broad, cymules somewhat elongating, foliar bracts not conspicuous; calyx densely setose but scarcely tomentose, in fruit showing some tendency to break away together with the pedicel; style exceeding the mature nutlets by 0.5–1.0 mm.

Distribution: Upper Sonoran Zone, central Utah and eastern Nevada. Type: sandy slides, Juab, Utah, June 9, 1902, *Goodding 1074*.

Specimens examined:

Utah: Price, June 11, 1900, *Stokes* (Calif.); Belknap, June 12, 1900, *Stokes* (Calif.); Juab, June 9, 1902, *Goodding 1074* (R.Mt., Mo., U.S., Gray, TYPE); Vermilion, June 4, 1901, *Jones* (Pomona); Monroe, May 12, 1899, *Jones* (Pomona); Detroit, near Oasis, May 26, 1891, *Jones 6698* (Pomona); Clifton, June 19, 1891, *Jones 6699* (Pomona); Desert Mts., n. w. of Oasis, May 20, 1891, *Jones 6700* (Pomona); Detroit, May 26, 1891, *Jones* (Pomona); Granite Mts., Tooele Co., June 7, 1900, *Jones 6705* (Pomona).

Nevada: Furber, e. Nevada, June 9, 1891, *Jones* (Pomona); Ferguson Spring, June 14, 1900, *Jones 6706* (Pomona).

32b. Var. **Shantzii** (Tidestr.) new comb. Plate 29, figs. 89–91.

Oreocarya Shantzii Tidestr. Proc. Biol. Soc. Wash. **26:** 122. 1913.

O. dolosa Macbr. Contr. Gray Herb. **48:** 32. 1916. (Type: College Bench, Logan, Utah, June 4, 1909, *Charles Piper Smith 1605*).

Long-lived, caespitose perennial; stem 10–20 cm. high; leaves spatulate, obtuse, 2–5 cm. long, tomentose and appressed-setose with slender more or less appressed bristles; inflorescence usually narrow, cymules only slightly elongating, lower foliar bracts rather conspicuous in the young inflorescence; calyx densely setose and subtomentose; styles scarcely exceeding the mature nutlets.

Distribution: Upper Sonoran Zone, central to northern Utah and southeastern Idaho. Type: College Bench, Logan, Cache County, Utah, June 4, 1909, *Charles Piper Smith 1605*.

Specimens examined:

Idaho: Pocatello, June 15, 1893, *Palmer 598* (U.S.); Pocatello, spring of 1921, *Soth P–9* (R.Mt.); Pocatello, May 17, 1909, *Slaughter 7* (R.Mt.); Soda Springs, June 22, 1892, *Mulford* (Minn., Gray); Nouman, June 5, 1913, *Schoper 28* (R.Mt.); Montpelier, May 15, 1910, *Macbride 2* (R.Mt., Wash., Calif., Minn., Field, U.S., Gray).

Utah: Logan, May 12, 1909, *Smith 1573* (R.Mt.); Logan, June 4, 1909, *Smith 1605* (R.Mt.); Robinson, June 26, 1909, *Jones* (Pomona); Salt Lake Co., May 15, 1903, *Garrett 266* (R.Mt., Gray); Salt Lake City, May 14, 1906, *Garrett 1737* (U.S.); benches near Salt Lake, May 15, 1900, *Stokes* (Calif.); Salt Lake City, May 20, 1900, *Stokes* (Minn., U.S.); Tintic Junction, May 9, 1910, *Jones* (Pomona); City Creek Canyon, April 28, 1889, *Jones* (Pomona); City Creek Canyon, May 19, 1880, *Jones 6719* (Pomona); Garfield, June 30, 1889, *Jones 6709* (Pomona); City Creek, Salt Lake Co., April 20, 1880, *Jones* (R.Mt.); City Creek Canyon, May 5, 1880, *Jones 1692* (R.Mt., Calif., U.S.); Grant's Station, south of Great Salt Lake, *Kearney & Shantz 3098* (U.S., TYPE); Ft. Douglas, Oct. 12, 1909, *Clemens* (R.Mt.); near Emigration Canyon, April 22, 1908, *Clemens* (Gray); Springville, 4400–5000 feet, May 17, 1913, *Hill* (Mo.); Cottonwood, Johnson's Pass, Tooele Co., June 6, 1900, *Jones* (Pomona); Nephi, April 25, 1910, *Jones* (Pomona); 3 miles south of Redmond, Sevier Co., May 31, 1915, *Eggleston 11132* (U.S.).

32c. Var. **ovina** new var.[1]

Densely caespitose, long-lived perennial; stems 10–15 cm. high; leaves spatulate or oblanceolate, obtuse, 2–4 cm. long, tomentose and appressed-setose with rather weak bristles; inflorescence narrow, or in age somewhat open due to the slight elongation of the cymules, lower foliar bracts scarcely conspicuous; calyx densely setose and tomentose; styles exceeding the mature nutlets by 0.5–1 mm.

[1] **Cryptantha nana** var. **ovina** Payson var. nov., perennis caespitosa; caulibus 10–15 cm. altis; foliis spathulatis aut oblanceolatis tomentosis et adpresse setulosis; sepalis dense tomentosis; nuculis muriculatis; stylo nuculas 0.5–1 mm. superante. —Collected by *Georgia H. Bentley*, in vicinity of Currant, Nye County, Nevada, June, 1916, (R. Mt., TYPE).

Distribution: Upper Sonoran Zone, southern Utah, and southern Nevada. Type: vicinity of Currant, Nye County, Nevada, June, 1916, *Georgia H. Bentley*.

Specimens examined:

Nevada: Wa Wa, June 25, 1906, *Jones* (Pomona); near Currant, June, 1915, *Bentley* (R.Mt., TYPE, Mo.); Charleston Mts., 1898, *Purpus 6070* (U.S.).

The variety *ovina* is most nearly related to the variety *Shantzii* and is distinguished from it chiefly by the more woolly leaves and calyces and the lower, more caespitose habit. From material at hand it would seem that the styles exceed the mature nutlets more in *ovina* than *Shantzii*.

32d. Var. **typica** n. var.

Oreocarya nana Eastw. Bull. Torr. Bot. Club **30**: 243. 1903.

Long-lived, densely caespitose perennial; stems 5–12 cm. high; leaves narrowly oblanceolate, 1–3 cm. long, setose with spreading bristles, rather coarsely strigose also; inflorescence narrow, cymules not elongating, foliar bracts inconspicuous; calyx densely setose and hirsute but scarcely tomentose; styles not exceeding the mature nutlets.

Distribution: Upper Sonoran Zone, western Colorado, and northeastern Utah. Type: "Collected by the author (*A. Eastwood*) near Grand Junction, Colorado, on the mesa above the Gunnison River, May 17, 1892."

Specimens examined:

Colorado: DeBeque, June 9, 1920, *Osterhout 5980* (R.Mt., U.S., Gray, Osterh.); Grand Junction, June 11, 1920, *Osterhout 6010* (Gray, Osterh.); near Grand Junction, May–Oct., 1898, *Purpus* (Calif.); Grand Junction, May 17, 1892, *Eastwood* (R.Mt., Calif., Gray).

Utah: north of Duchesne, June 22, 1922, *Osterhout 6200* (R.Mt.); Theodore, May 14, 1908, *Jones* (Pomona).

The aggregate treated here as *C. nana* is distinguished chiefly by the short corollas and the uniformly muricate nutlets. These are characters possessed also by *C. cana* and *C. breviflora* but those species have conspicuously sericeous, minutely pustulate leaves, while in *C. nana* the leaves always have the two kinds of

trichomes and are either distinctly tomentulose or at least conspicuously pustulate.

In any general floristic work, the author would have no hesitation in submerging the varieties recognized here and would use only the specific name for the assemblage—so close are the varieties and so numerous the intermediates. They seem to be geographic units and so are worthy of discrimination in a more technical treatment.

33. C. cana (A. Nels.) new comb. Plate 29, figs. 92–94.

Oreocarya cana A. Nels. Bot. Gaz. **34:** 30. 1902.

Krynitzkia sericea Nutt., fide Rydb. Fl. Rocky Mountains, 723. 1917. This combination was neither published nor suggested by Nuttall since he never used the generic name *Krynitzkia*.

Very densely caespitose long-lived perennial; leaves narrowly oblanceolate, usually acute, clustered on the crowns of the caudices, 2–6 cm. long, densely and, to the naked eye, uniformly silky strigose, older leaves under the lens inconspicuously pustulate below and setose with setae that are scarcely differentiated from the strigose hairs, upper surface obscurely pustulate; inflorescence narrow, mainly restricted to the upper ½ of the stem, densely but rather weakly setose, foliar bracts inconspicuous; calyx rather finely setose, sepals in anthesis linear or linear-lanceolate, acute, 3 mm. long, in fruit 5.5–6 mm. long, exceeding the mature nutlets by 3–4 mm.; corolla white, tube about 3 mm. long, as long as the calyx lobes, crests at the base of the tube evident, fornices distinctly papillose, low, rounded, about 0.5 mm. high, probably yellow, limb about 6 mm. broad, tube and corolla lobes subequal, lobes united for about ¼ their length; fruit usually unsymmetrical, tending to be lance-ovoid, only one nutlet usually maturing, style shorter than the mature nutlet; nutlets lanceolate, acute, 3–3.5 mm. long, margins in contact (when more than one develops), acute or obtuse, surfaces of nutlets dull, the dorsal densely muricate with elongated and sometimes confluent papillae, the ventral surfaces similar but papillae less elevated, scar open toward the base, rather narrowly triangular, no elevated margin present.

Distribution: Upper Sonoran Zone, central to southeastern

Wyoming, northeastern Colorado, and western Nebraska. Type: gravelly open hilltops, Ft. Laramie, Wyoming, *A. Nelson 8309*.

Specimens examined:

Nebraska: Ft. Robinson, June 1, 1890, *Bates* (N.Y.); War Bonnet, June 24, 1890, *Williams* (N.Y.); McColligan Canyon, Deuel Co., June 26, 1891, *Rydberg 256* (U.S., N.Y.); Sidney, May 23, 1922, *Nelson* (R.Mt.).

Wyoming: Birds Eye, June 25, 1910, *Nelson 9367* (R.Mt.); Pine Bluffs, June 27, 1889, *Bodin* (Minn.); Pine Bluffs, May 14, 1897, *Nelson 2876* (R.Mt., Calif., Field); Uva, July 10, 1894, *Nelson 389* (R.Mt.); Ft. Laramie, June 29, 1901, *Nelson 8309* (R.Mt., TYPE, Gray); Platte Hills, *Nuttall* (Phila.).

Colorado: Pawnee Buttes, Weld Co., June 17, 1919, *Osterhout 5902* (R.Mt., U.S., Gray, Osterh.); Tuttle, May 16, 1909, *Cary 276* (U.S.).

This is a most distinct species by virtue of its densely caespitose habit, its silky strigose indument, and muricate nutlets. It has no near relatives with which it might be confused in the region where it grows.

34. C. propria (Nels. & Macbr.) new comb.

Plate 29, figs. 95–97.

Krynitzkia fulvocanescens var. *idahoensis* Jones, Contr. West. Bot. **13:** 6. 1910. (Type: *Jones* No. *6474*, near Weiser, Idaho, April 28, 1900.)

Oreocarya propria Nels. & Macbr. Bot. Gaz. **62:** 145. 1916.

Densely caespitose, long-lived perennial; stems few to many from the branched, woody caudex, 15–25 cm. high, rather slender, sparsely and weakly setose, caudex densely clothed with the leaf-bases of previous years; leaves clustered on the crowns of the caudex, spatulate, obtuse, 4–8 cm. long, dorsal surface finely strigose and abundantly appressed-setulose with short pustulate bristles, ventral surface densely and finely strigose with a few pustulate hairs, petioles ciliate near the base with long white hairs; inflorescence narrow, continuous or nearly so, confined to the upper ½ or ⅔ of the stem, densely but rather weakly setose, foliar bracts not conspicuous; calyx densely and weakly setose

and hirsute, sepals in anthesis linear or linear-lanceolate, 4–6 mm. long, acute, in fruit 8–10 mm. long, exceeding the nutlets by about 5 mm.; corolla white, tube 3.5–5 mm. long, tube and sepals subequal, crests at base of tube conspicuous, fornices nearly 1 mm. high, probably yellow, finely papillose, limb about 7 mm. broad, lobes and tube subequal or the tube slightly longer, lobes united for about ⅓ their length; fruit ovoid, four nutlets commonly maturing, style exceeding the mature nutlets 2–3 mm.; nutlets lanceolate, acute or nearly so, 3–4 mm. long, margins acute, surfaces of nutlets dull, the dorsal densely and sinuously rugulose with narrow but relatively high ridges, conspicuously muricate near the margins, the ventral surfaces densely but not uniformly muriculate, these elevations sometimes irregularly confluent, scar narrow but slightly open, extending from the base nearly to the apex, no elevated margin evident.

Distribution: clay hillsides in the Upper Sonoran Zone of western Idaho and adjacent Oregon. Type: Vale, Malheur County (Oregon), May 14, 1896, *J. B. Leiberg 2049*.

Specimens examined:

Idaho: 18 miles below Weiser, April 28, 1900, *Jones 6474* (Pomona, Mo.).

Oregon: Malheur Valley near Harper Ranch, June 8, 1896, *Leiberg 2223* (Calif., U.S., Gray, TYPE); Vale, Malheur Co., May 14, 1896, *Leiberg 2049* (Pomona, Calif., Field, U.S., Gray).

It is difficult to say to what species this plant is most nearly related. It would perhaps be most easily confused with *C. cana* or *C. breviflora* but those are plants far removed from it geographically, and *C. propria* may not be very closely related to either. *C. propria* must stand as a very distinct specific unit.

35. C. breviflora (Osterh.) new comb.

Oreocarya breviflora Osterhout, Univ. Wyo. Publ. Bot. **1:** 169. 1926.

Long-lived perennial from a woody root; stems rather slender, solitary or few, 15–25 cm. high, white-hairy at the base with long, straight, appressed trichomes, strigose upwards and hirsute near the inflorescence; leaves conspicuously clustered near the base, oblanceolate to spatulate, obtuse, 2.5–5 cm. long, uniformly

silky strigose, pustulate hairs scarcely distinguishable from the others and difficult of observation in dried material, pustules very numerous on dorsal surface, few and small on ventral surface; inflorescence rather narrow, nearly continuous, on upper ½–¾ of stem, foliar bracts small, inconspicuous, inflorescence setose-hispid with divaricate bristles that (sometimes at least) become yellowish in age; calyx setose, sepals in anthesis linear or nearly so, acute, 4–5 mm. long, in fruit 8–10 mm. long, exceeding the nutlets by about 4 mm.; corolla white, tube 3–4 mm. long, slightly shorter than the sepals, crests evident at the base of the tube, fornices small, rounded, nearly closing the throat, 1 mm. or less long, yellow, limb 7–9 mm. in diameter, limb and tube subequal, lobes united for about ⅓ their length; fruit ovoid, usually less than 4 nutlets maturing, style very slightly (0.5 mm.) exceeding the mature nutlets; nutlets lanceolate in outline, acute or obtuse, 4 mm. long, margins in contact, acute, apices somewhat spreading, surfaces of nutlets dull, the dorsal uniformly muriculate, the ventral similar, scar open, triangular, extending from the base to near the middle of the nutlet, margin not elevated.

Distribution: northeastern Utah, probably in the upper part of the Upper Sonoran Zone. Type: 6½ miles north of Jensen (Utah), *Osterhout 6414*.

Specimens examined:

Utah: 6½ miles north of Jensen, June 19, 1925, *Osterhout 6414* (R.Mt., TYPE, Osterh.); Uinta Mts., 1902, *Langille 113* (N.Y., U.S.); Ft. Duchesne, May 22, 1908, *Jones* (Pomona).

C. breviflora is evidently closely related to *C. fulvocanescens*. It differs from that species chiefly by the short corolla tube and the low fornices. The ranges of the two seem consistently separated.

36. C. fulvocanescens (Gray) new comb.

Eritrichium fulvocanescens Gray, Proc. Am. Acad. **10**: 61. 1875.
Krynitzkia fulvocanescens Gray, Proc. Am. Acad. **20**: 280. 1885.
Oreocarya fulvocanescens (Gray) Greene, Pittonia **1**: 58. 1887.
O. nitida Greene, Pl. Baker. **3**: 21. 1901. (Type: in dry stony ground at Deer Run, Colorado, 11 June, *C. F. Baker 95*.)

Perennial and caespitose from a woody root; stems few to

many from the root, rather slender, 12–25 cm. high, white-hairy at the base with long, straight-appressed trichomes, strigose and hirsute upwards; leaves conspicuously clustered near the base, oblanceolate to linear-oblanceolate, usually acute, 2–8 cm. long, uniformly silky strigose, pustulate hairs scarcely differentiated and difficult of observation in dried material, pustules numerous on dorsal surface, few and small on ventral surface; inflorescence rather narrow, nearly continuous, on upper ½ or ¾ of the stem, softly setose-silky at first, later becoming more hispid, bristles usually turning yellowish with age, foliar bracts small, inconspicuous; calyx weakly but densely setose, sepals in anthesis linear or nearly so, acute, 6–8 mm. long, in fruit about 12 mm. long, exceeding the nutlets by 6–8 mm.; corolla white, tube 9–11 mm. long, exceeding the sepals by 2–4 mm., crests lacking at the base of the tube, fornices conspicuous, yellow, elongated, over 1 mm. long, spreading, limb 7–9 mm. in diameter, about ⅓ as long as the tube, lobes united for ¼ their length or less; fruit ovoid, 1–2 nutlets only usually maturing, style exceeding the mature nutlets by 2–5 mm. (species conspicuously heterostyled); nutlets lanceolate in outline, acute or obtuse, 4 mm. long, margins in contact (when more than 1 nutlet matures), apices somewhat spreading, margins acute or nearly obtuse, surfaces of nutlets dull, the dorsal densely and uniformly muriculate, the ventral similar, scar short, nearly closed, extending from the base about ⅓ the distance to the apex, margins not elevated.

Distribution: Upper Sonoran Zone in southwestern Colorado, northeastern New Mexico, southeastern Utah, and northeastern Arizona. Type: near Santa Fe, New Mexico, *Fendler 632*.

Specimens examined:

Colorado: Grand Junction, June 11, 1920, *Osterhout 6003* (R.Mt., U.S., Gray, Osterh.); Deer Run, June 11, 1901, *Baker 95* (Pomona, R.Mt., Calif., Mo., U.S., Gray); Grand Junction, May 17, 1892, *Eastwood* (R.Mt., U.S., Gray); Westwater, May 6, 1891, *Jones* (Pomona); Naturita, May 4, 1914, *Payson 271* (R.Mt., Minn., Field, Gray, Colo.); Naturita, June 26, 1924, *Payson & Payson 3876* (R.Mt., Mo., Gray); Paradox, June 13, 1912, *Walker 85* (R.Mt., Pomona, Minn., Mo., U.S., Gray); Paradox, June 21, 1912, *Walker 156* (R.Mt., Minn., U.S., Gray).

New Mexico: Gallup, June 14, 1916, *Eastwood 5596* (U.S., Gray); Aztec, Aug. 1899, *Baker 561* (Pomona, R.Mt., Mo., U.S., Gray); Bloomfield, San Juan Co., 1892, *Waring 15* (Phila.); near Santa Fe, 1847, *Fendler 632* (Field, Phila., Mo., U.S., Gray, TYPE); hills at Santa Fe, May 13, 1897, *A. A. & E. G. Heller 3517* (Minn., Mo., U.S.).

Utah: Cisco, May 2, 1890, *Jones* (Pomona, R.Mt., Calif.).

Arizona: 18 miles north of Holbrook, May 21, 1901, *Hough 39* (U.S.); Holbrook, May 6, 1899, *Zuck* (U.S.).

This is a very distinct species characterized by the long corollas with the elongated fornices, the silky indument, and the nutlets that are densely and uniformly muriculate. It is most likely to be confused with *C. echinoides* and *C. breviflora*. From the former it differs in the muriculations of the nutlets which may be acute but are never truly setose; from the latter in the long corolla and elongated fornices.

37. C. echinoides (Jones) new comb.

Krynitzkia echinoides Jones, Proc. Calif. Acad. Sci. II. **5:** 709. 1895.

Oreocarya echinoides (Jones) Macbr. Contr. Gray Herb. **48:** 31. 1916, as to synonymy, not as to specimens cited.

Caespitose perennial very similar in general appearance to *C. fulvocanescens;* stems 12–20 cm. tall; leaves crowded at the base, oblanceolate to spatulate, usually acute, 3–6 cm. long, dorsal surface strigose and densely appressed-setose with numerous pustulate hairs, ventral surface densely strigose, setae and pustules nearly or quite lacking, petioles somewhat ciliate at the base; inflorescence extending over upper ¾ of the stem, narrow, continuous, fulvous-setose, foliar bracts inconspicuous, calyx densely setose with spreading or divaricate, yellowish (in age) hairs, sepals in anthesis about 5 mm. long, linear or nearly so, acute, in fruit about 10 mm. long, exceeding the nutlets by about 6 mm.; corolla white or cream-colored, tube 8–9 mm. long, exceeding the sepals by 1.5–3 mm., crests at base of tube sometimes evident, fornices conspicuous, probably yellow, elongated, erect or spreading, 1–1.5 mm. long, limb 7–9 mm. in diameter, lobes nearly half as long as the tube, united for ¼–⅓ their length;

fruit lance-ovoid, fewer than 4 nutlets maturing (usually 1 or 2?), style exceeding mature nutlets 4–6 mm.; nutlets lanceolate in outline, nearly acute, about 4 mm. long, margins acute, probably in contact, surfaces of nutlets not glossy, the dorsal densely and uniformly papillose, each papilla usually bearing a short seta from the apex, sometimes several setae from a single large papilla, median dorsal ridge often evident, ventral surface similar, scar narrow, often unsymmetrical, extending from the base to about the middle of the nutlet, margin not elevated.

Distribution: Upper Sonoran Zone in southern Utah and adjacent Arizona. Type: Pahria Canyon, Utah, 5300 ft. alt., in red sand, *M. E. Jones 5279p.*

Specimens examined:

Utah: Pahria Canyon, May 26, 1894, *Jones 5297p* (Pomona, TYPE); Cannonville, May 28, 1894, *Jones 5312 ac* (Pomona, Calif., U.S.).

Arizona: Navajo Spring, near Johnson City, June 19, 1890, *Jones* (Pomona).

C. echinoides was entirely misunderstood and misinterpreted by Macbride in Proc. Am. Acad. **51:** 547. 1916, and in Contr. Gray Herb. **48:** 31. 1916. From the specimens cited by Macbride it is evident that he never saw a specimen of true *echinoides* and his interpretation of the identity of the species was apparently obtained from Jones' discussion of the identity of *fulvocanescens.* With Jones' specimens at hand there can be no doubt as to the plant that should bear the name of *echinoides.* Two collections are cited by Jones as representing his new species, and these two are essentially identical. His description very clearly applies to the collections cited and so the plant with hedgehog-like nutlets from Pahria Canyon and from Cannonville must be taken as true *echinoides.* Jones took Watson's plant from Utah (*Eritrichium glomeratum* var. *fulvocanescens* Wats. Bot. King's Exp. 243. 1871) as being the plant that must bear the specific name *fulvocanescens.* The first legal publication of this name is this publication of Watson's, and the type of his variety is the Utah plant collected by Fremont rather than the Fendlerian collection designated by Gray in manuscript. Whatever the type of Watson's variety may be, it does not bear on the case in hand.

The first specific use of the name *fulvocanescens* is in connection with Fendler's plant from Santa Fe, and so that plant becomes the type of the species *fulvocanescens* of Gray. It is not surprising that Jones considered his plant from Pahria Canyon and Fendler's plant from Santa Fe as conspecific; the two are certainly very closely related.

Although available material of *echinoides* is somewhat scanty it seems that the flowers in this species are only slightly dimorphic. The difference between the point of attachment in stamens from flowers assumed to represent the two forms is not over 1.5 mm. In *C. fulvocanescens* the difference is distinctly greater.

38. C. Jonesiana (Payson) new comb. Plate 29, figs. 98–100.

Oreocarya Jonesiana Payson, Univ. Wyo. Publ. Bot. **1:** 168. 1926.

Densely caespitose perennial from a woody root; caudex much branched, the branches clothed with the remains of leaves of previous years; stems 6–8 cm. tall, rather slender, sparsely setose and coarsely strigose; basal leaves numerous, thick, spatulate to obovate-spatulate, 1.5–3.5 cm. long, obtuse, blade abruptly or gradually reduced to the slender petiole, cauline leaves few, spatulate, smaller, leaf surfaces appressed-setose and coarsely strigose, the petioles not ciliate, pustulate hairs present and conspicuous on both surfaces, somewhat more numerous on dorsal; inflorescence mostly confined to upper ½ of stem, narrow, cymules nearly sessile, foliar bracts inconspicuous, inflorescence densely and coarsely fulvous-setose; calyx densely setose, sepals in anthesis linear, acute, about 7 mm. long, in fruit about 10 mm. long, exceeding the nutlets 4–5 mm.; corolla probably white with yellow fornices, tube 13–15 mm. long, 6–8 mm. longer than the sepals, rather conspicuously flaring in the throat, crests at the base of the tube obsolete, fornices very broad and low, spreading, limb 10–12 mm. broad, lobes not over ⅓ as long as the tube, united for about ¼ their length; fruit lance-ovoid, apparently only 2–3 nutlets usually maturing, style exceeding the mature nutlets 4–5 mm. (species apparently only slightly heterostyled); nutlets lanceolate in outline, obtuse or acute, about 4 mm. long, margins in contact, acute, apices scarcely spreading, surfaces dull,

the dorsal muricate and sometimes distinctly rugose due to the confluence of the murications, slightly keeled, the elevations usually acute and often tipped with a distinct seta, ventral surface similar to the dorsal but elevations somewhat fewer and lower, scar narrow, straight, open, extending from the base $^4/_5$ of distance to apex, no elevated margin.

Distribution: Upper Sonoran Zone in south-central Utah. Type: San Rafael Swell, *Jones*.

Specimens examined:

Utah: San Rafael Swell, May 15, 1914, *Jones* (Pomona, TYPE); San Rafael Swell, May 19, 1914, *Jones* (Pomona).

This species seems most closely related to *C. fulvocanescens* and *C. echinoides* but is much more distinct from them than they are from one another. It differs from them by its more densely caespitose habit, lower stems, harsher pubescence, less conspicuously dimorphic flowers, lower and broader fornices, and slightly rugose nutlets.

Series 5. FLAVOCULATAE. Nutlets usually deeply and conspicuously rugose and tuberculate, sometimes muricate or foveolate also. Scar, except in *C. Bakeri*, at least slightly open and then showing a tendency to be constricted above the base, margin usually elevated. Species 39–46.

39. C. Wetherillii (Eastw.) new comb. Plate 30, figs. 101–103.

Krynitzkia glomerata var. *acuta* Jones, Zoe **2:** 250. 1891. (Type: "Collected May 2, 1890, at Cisco, Utah.")

Oreocarya Wetherillii Eastw. Bull. Torr. Bot. Club **30:** 242. 1903.

Short-lived perennial or biennial; stem stout, branched from the base with one stout stem and often with one or more low slender ones, 1.5–3 dm. high, densely strigose and conspicuously setose with long white divaricate bristles; radical leaves spatulate or oblanceolate, obtuse or acute, 1–3 cm. long, rather coarsely strigose dorsally and rather shortly setose with spreading but scarcely divaricate bristles, ventral surface more finely strigose, not setose, pustules abundant on dorsal surface, nearly or entirely absent on ventral (sometimes more abundant in age), petioles broad, scarcely ciliate; cauline leaves narrower, scarcely petioled,

usually acute, 1.5–5 cm. long; inflorescence on upper ¾ of the stem, rather broad and open, not interrupted, cymules elongating, setose, foliar bracts rather conspicuous below, diminishing upwards; calyx abundantly setose, sepals linear-lanceolate, acute, 5–6 mm. long in anthesis, in fruit about 1 cm. long, exceeding the mature nutlets by about 6 mm.; corolla white, tube 6–7 mm. long, exceeding the calyx lobes by about 2 mm., crests at the base of the tube absent or inconspicuous, fornices probably yellow, conspicuously long-papillose, emarginate, about 1 mm. long, limb 10–12 mm. broad, tube about twice as long as the lobes, lobes united for about ⅓ their length; fruit ovoid, 3–4 nutlets usually maturing, style exceeding the mature nutlets 3–4 mm.; nutlets rather broadly lanceolate, obtuse or subacute, about 4 mm. long, margins acute, in contact, surfaces of nutlets slightly glossy, dorsal with numerous conspicuous rounded tubercles that are at times somewhat confluent and so tend to form rugae, not muriculate, ventral surface similar but tubercles lower, some confluent, scar narrow but open, surrounded by a distinct elevated margin.

Distribution: Upper Sonoran Zone, east-central Utah. Type: "Collected by the author [*Eastwood*] in flower and fruit, May 25, 1892, in Court House Wash, near Moab, southeastern Utah."

Specimens examined:

Utah: Court House Wash, near Moab, May 25, 1892, *Eastwood* (Calif., part of TYPE); Cisco, May 2, 1891, *Jones* (Calif., Mo., U.S., Gray); Green River, May 7, 1891, *Jones* (R.Mt., Calif., Pomona); Price, 1900, *Stokes* (Calif.); Price, June 29, 1898, *Jones* (Pomona).

C. Wetherillii is most closely related to *C. longiflora*, and at one time the author felt that they could not be separated specifically. However, more careful study has seemed to show that they are definitely distinct. The differences between the two species may be contrasted as follows:

C. Wetherillii	*C. longiflora*
Radical leaves distinctly pustulate below, scarcely so above.	Pustulate hairs about equally distributed on both surfaces.
Species not known to have dimorphic flowers (this may be due to lack of specimens).	Species with evidently dimorphic flowers.

Fornices long-papillose or "hispid."	Fornices scarcely papillose at all.
Corolla tube 6–7 mm. long.	Corolla tube 12–14 mm. long.
Nutlets tuberculate and more or less rugose.	Nutlets distinctly rugose, scarcely tuberculate.
Scar open but narrow, slightly broader near the middle, surrounded by a distinct elevated margin.	Scar very narrow, sides nearly parallel, elevated margin not evident or very slight.

40. C. longiflora (A. Nels.) new comb. Plate 30, figs. 104–106.

Oreocarya longiflora A. Nels. Erythea **7:** 67. 1899.

O. horridula Greene, Pl. Baker. **3:** 20. 1901. (Type: Deer Run, Colorado, 11 June, on a dry bank, *C. F. Baker 133.*)

A short-lived perennial (possibly at times a biennial); stems several (1–5), unbranched, rather stout, 10–30 cm. tall, conspicuously setose with long, divaricate bristles, hirsute; leaves clustered near the base of the stem, oblanceolate, spatulate or nearly obovate, obtuse, 2.5–7 cm. long, blade narrowed to a broad, setose petiole, blade setose with ascending rather than strongly divaricate bristles, sparingly hirsute, some smaller contorted hairs also present on the surface, pustulate hairs about equally distributed on the two surfaces; inflorescence occupying ¾ or more of the stem, rather broad and loose, bracts not exceeding the flowers, whole inflorescence strikingly setose with long straight bristles; calyx strongly setose-hairy, sepals in anthesis linear-lanceolate to nearly linear, acute, 8–10 mm. long, in fruit 10–12 mm. long, erect, exceeding the nutlets by 7–10 mm.; corolla white, conspicuously dimorphic, tube 12–14 mm. long, usually exceeding the calyx lobes by 2–4 mm., crests at the base lacking, fornices not over 1 mm. long, yellow, broad, rounded, or emarginate, they and the upper part of the tube papillose, limb about 10 mm. in diameter, lobes ¼ to ⅓ as long as the tube, united about ¼ their length from throat; fruit ovoid, 2, 3 or 4 nutlets maturing (apparently usually less than 4), styles exceeding mature nutlets 3–6 mm.; nutlet margins nearly in contact, acute, surfaces of nutlets pale, somewhat glossy, the dorsal surface densely tuberculate and more or less rugose, tubercles and rugae usually rounded on the top, the

ventral surface similar, scar straight, closed or narrowly open, surrounded by a slightly elevated tuberculate margin.

Distribution: Upper Sonoran Zone in west-central Colorado and probably adjacent Utah. Type: "Collected by Prof. *C. S. Crandall*, at Palisades, Mesa Co., Colo., May 14, 1898."

Specimens examined:

Colorado: DeBeque, Mesa Co., May 19, 1911, *Osterhout 4463* (R.Mt.); Delta, May 20, 1911, *Osterhout 4497* (R.Mt.); DeBeque, June 9, 1920, *Osterhout 5975* (R.Mt., U.S., Gray); Grand Junction, May 14, 1892, *Eastwood* (Pomona, U.S., Gray); Palisades, Mesa Co., May 14, 1898, *Crandall* (R.Mt., TYPE); Westwater, May 6, 1891, *Jones* (Pomona); Montrose, May 23, 1912, *Payson 35* (R.Mt.); Montrose, June 14, 1914, *Payson 659* (R.Mt., Gray).

C. longiflora is perhaps most closely related to *C. Wetherillii* and is most likely to be confused with that species. For a comparison of these two species see the discussion under *C. Wetherillii*.

O. horridula Greene has not been seen except for a few fragments from the type. A comparison of mature nutlets with those of *C. longiflora* shows them to be most similar; a comparison of *longiflora* with the description of *horridula* reveals no important differences; the type locality of *horridula* at Deer Run makes it very probable that the two are identical.

41. C. tenuis (Eastw.) new comb. Plate 30, figs. 107–109.

Oreocarya tenuis Eastw. Bull. Torr. Bot. Club **30**: 244. 1903.

Perennial, more or less caespitose; stems several to many from the base, slender, 15–25 cm. high, strigose and divaricate-setose with rather short, weak bristles; leaves clustered at the base, rather few on the stem, linear-spatulate, obtuse or subacute, 2–4 cm. long, strigose and weakly appressed-setose on the dorsal surface, uniformly strigose on ventral surface, densely pustulate dorsally, sparsely, if at all, pustulate ventrally, petioles scarcely ciliate; inflorescence extending over upper ½ to ¾ of the stem, rather narrow, uninterrupted, rather weakly but abundantly setose, foliar bracts inconspicuous; calyx strigose and abundantly short-setose, sepals in anthesis narrowly lanceolate, acute, 4–5 mm. long, in fruit 6–7 mm. long, exceeding the nutlets by 3–4 mm.;

corolla white, tube 6 mm. long, slightly exceeding the sepals in anthesis (not over 1 mm.), crests at the base of the corolla tube present or absent, fornices probably yellow, broad, truncate, emarginate, about 0.5 mm. high, distinctly papillose, limb unusually campanulate for the genus, about 5 mm. across, tube 1.5–2 times as long as the limb, lobes united for about ⅓ their length, anthers with their apices about on a level with the tops of the fornices; fruit ovoid, 3–4 nutlets usually maturing (?), style exceeding the mature nutlets by about 4 mm.; nutlets lanceolate in outline, nearly acute, about 4 mm. long, margins in contact, acute, surfaces of nutlets dull, the dorsal sharply and deeply rugose, with an evident but sinuous or flexuous dorsal ridge, sparingly tuberculate, not at all muriculate, the ventral surface sharply rugose, scar narrow but evidently open, surrounded by an elevated margin. No evidence is at hand to show that this species is dimorphic in flower structure. With so few collections available, however, it is possible that they may all represent one form.

Distribution: Upper Sonoran Zone in southeastern Utah. Type: "near Moab, in Court House Wash, southeastern Utah, May 25, 1892," *Alice Eastwood.*

Specimens examined:

Utah: without locality, May–Oct. 1898, *Purpus* (Calif.); Court House Wash., s.e. Utah, May 25, 1892, *Eastwood* (R.Mt., Calif., Gray).

C. tenuis, although known from but two collections, possesses characters that seem to prove its right to specific recognition. These outstanding characteristics are (1) the corolla tube that slightly, but definitely, exceeds the calyx lobes, (2) the campanulate rather than spreading limb of the corolla, (3) the anthers whose apices are on a level with the fornices, (4) the sharply and deeply rugose nutlets, (5) the narrow leaves and slender erect stems. As is the case in most species of the section *Oreocarya*, it is difficult to say to what species it is most closely related. For one reason and another it seems nearest to *Osterhoutii* (from which it differs by the tall stems and longer corolla tube), to *longiflora* (from which it differs in the shorter corolla tube, sharply rugose nutlets, shorter setae), and to *Wetherillii* (from which it differs by the narrower leaves, sharply rugose nutlets, and much smaller flowers).

42. C. Osterhoutii (Payson) new comb. Plate 30, figs. 110–112.
Oreocarya Osterhoutii Payson, Univ. Wyo. Publ. Bot. **1:** 167. 1926.

Densely caespitose perennial; caudices much branched and clothed with the leaf-bases of previous years; stems slender, 2–6 cm. high, near the base covered with long, white, mostly appressed hairs, strigose and weakly setose upwards; leaves spatulate or oblanceolate, usually obtuse, 1–1.5 cm. long, strigose and appressed-setose on dorsal surface, almost uniformly strigose on ventral surface, pustulate hairs lacking on ventral surface, well developed on dorsal, petioles somewhat ciliate; inflorescence reduced but open, on upper ¾ of the stem, rather softly and shortly setose, foliar bracts inconspicuous; calyx strigose-hirsute and sparsely and weakly setose, sepals in anthesis linear-lanceolate, acute, 2–4 mm. long, in fruit 5–6 mm. long, exceeding the mature nutlets by 2–3 mm.; corolla white, tube about 3 mm. long, equalling the sepals in anthesis, crests at the base of the tube usually evident, poorly developed, fornices yellow, broad and low (0.5 mm. long), emarginate, distinctly papillose, limb 5–7 mm. broad, tube and limb subequal, lobes united for about ⅓ their length; fruit broadly ovoid, in the material examined only 1 or 2 nutlets have matured, style exceeding the mature nutlets by about 0.5 mm.; nutlets turgid, lanceolate in outline, acute, 3 mm. long, somewhat incurved margins usually not in contact, obtuse, surfaces of nutlets somewhat glossy, the dorsal indefinitely carinate, sharply tuberculate and somewhat rugose, the ventral tuberculate with fewer tubercles, scar open, extending at least ½ the length of the nutlet, evident, elevated and tuberculate margin present.

Distribution: Upper Sonoran Zone in western Colorado and eastern Utah. Type: Monument Park, near Grand Junction, Colorado, *Geo. E. Osterhout 6138*.

Specimens examined:

Colorado: Grand Junction, Monument Park, June 3, 1921, *Osterhout 6138* (R.Mt., TYPE, Colo., Osterh.).

Utah: Court House Wash, June 16, 1913, *Jones* (Pomona).

This species is one of the most densely caespitose members of the genus. For this reason and because of the short stems it

might be confused with *C. nana*. The resemblance, however, between the two species is quite superficial. It seems to be most closely related to *C. paradoxa*. The short corollas separate it definitely from that species.

43. C. paradoxa (A. Nels.) new comb. Plate 30, figs. 113–115.

Oreocarya paradoxa A. Nelson, Bot. Gaz. **56:** 69. 1913.

O. gypsophila Payson, Bot. Gaz. **60:** 380. 1915. (Type: "on a dry gypsum hill in Paradox Valley, Colorado, alt. slightly over 5000 ft., *Payson 458*, June 18, 1914.")

Densely caespitose perennial; caudices much branched and clothed with the leaf-bases of previous years; stems slender, 5–12 cm. high, somewhat white-hairy near the base, more or less strigose and weakly setose above; leaves crowded on the end of the branches of the caudex, spatulate or oblanceolate, usually folded, obtuse, 1.5–3 cm. long, strigose and appressed-setose on the dorsal surface, uniformly strigose on the ventral surface, pustulate hairs lacking on the ventral surface, well developed on the dorsal, petioles somewhat ciliate; inflorescence reduced but not congested, on upper ½–¾ of stem, hirsute or weakly setose, foliar bracts inconspicuous; calyx weakly setose with spreading hairs, sepals in anthesis linear-lanceolate, acute, 4–5 mm. long, in fruit 7–8 mm. long, exceeding the mature nutlets by about 5 mm.; corolla white, tube 10–12 mm. long, 2–3 times as long as the sepals, crests at base of tube lacking, fornices yellow, broad and low (0.5 mm. high), slightly emarginate, distinctly papillose, limb 10–12 mm. broad, tube about 2½ times as long as the lobes, lobes united for about ¼ their length; fruit oblate-ovoid, all 4 nutlets usually maturing, style exceeding the mature nutlets by 4–8 mm. (species conspicuously heterostyled); nutlets lanceolate in outline, acute or obtuse, turgid, 2–3 mm. long, not incurved, margins not in contact, obtuse, surfaces of nutlets slightly glossy, dorsal surface not carinate, densely tuberculate and rugose, definitely margined, the ventral tuberculate, scar open, extending at least ½ the length of the nutlet, margin slightly elevated.

Distribution: Upper Sonoran Zone, western Colorado, and eastern Utah. Type: on dry "gyp" hills, in Paradox Valley, Colorado, *E. P. Walker 91*.

Specimens examined:

Colorado: Paradox, Montrose Co., June 17, 1912, *Walker 91* (R.Mt., TYPE, Pomona, Minn., Mo., U.S., Gray); East Paradox Valley, June 20, 1924, *Payson & Payson 4223* (R.Mt., Mo., Gray); Paradox Valley, June 18, 1914, *Payson 458* (R.Mt., Mo., Gray).

Utah: Myton, May 20, 1908, *Jones* (Pomona).

This species is conspicuously dimorphic in flower structure. The stamens in the two forms are attached 4–5 mm. apart and the styles differ in length by about the same amount. In the original description of *paradoxa* the anthers are described as being "just below the crests." On the type sheet in the Rocky Mountain Herbarium, three plants are fastened; on two of these the anthers are as described, on the third plant they are attached about half way up the tube. In the original description of *gypsophila* the anthers are said to be "attached about midway on the corolla tube." All the specimens preserved on the type sheet in the Rocky Mountain Herbarium have anthers attached just below the fornices. This is to be explained by supposing that the specimens from which the description was drawn were distributed and other plants were kept to represent the type and at the time these two specific names were proposed neither Dr. Nelson nor the writer suspected the dimorphic nature of the flowers. Due to the fact that the flowers had discolored somewhat in fading, Dr. Nelson described them as yellow. The author knew his plant to have white flowers. Unfortunately the specimens of *paradoxa* had not yet been mounted and so were not available when *gypsophila* was described. However, there can be no doubt but that the two names are completely synonymous.

C. paradoxa is unique in the possession of a long corolla tube, densely caespitose habit, and conspicuously rugose and tuberculate nutlets that are not in contact on the margins. Its nearest relative is perhaps *C. Osterhoutii.* That species may be distinguished at once by the short corollas.

44. C. Bakeri (Greene) new comb. Plate 30, figs. 116–118.

Oreocarya Bakeri Greene, Pittonia **4:** 92. 1899.

O. eulophus Rydb. Bull. Torr. Bot. Club **31:** 637. 1904.

(Type: Dolores, Colorado, 1892, *Crandall.*)

Evidently perennial, probably short-lived, from a stout root; caudex with few to several rather short branches; stems 1–8 (rarely more), rather slender, 12–30 cm. high, densely setose with horizontal bristles, hirsute; leaves somewhat clustered at the base, oblanceolate, blade narrowed to a distinct, setose petiole, obtuse, 4–8 cm. long, dorsal surface appressed and rather finely setose with numerous pustulate hairs and coarsely strigose, ventral surface densely strigose and with a few inconspicuous, appressed, pustulate setae; inflorescence occupying upper $^4/_5$, or more, of stem, somewhat glomerate, foliar bracts few, linear-oblanceolate, exceeding the cymules, often reflexed; calyx setose and hirsute, sepals in anthesis lanceolate-acuminate, about 6 mm. long, in fruit ovate-lanceolate, shortly acuminate, about 9 mm. long, exceeding mature nutlets 4–5 mm.; corolla white, tube 6–7 mm. long, usually very slightly longer than the sepals in anthesis, crests at base of tube evident, fornices yellow, conspicuous, linear, emarginate, about 2 mm. long, papillose, limb 7–8 mm. broad, nearly twice as long as the radius of the limb, united portion $^1/_2$ as long as the lobes or less; fruit broadly ovoid, 2–3 or (usually) 4 nutlets maturing, style 1–2 mm. longer than nutlets; nutlets ovate-lanceolate in outline, obtuse, turgid, 3–3.5 mm. long, margins not closely in contact, obtuse, surfaces of nutlets rather dull, the dorsal densely and irregularly rugose and tuberculate, sometimes more or less foveolate, rugae and tubercles usually acute, ventral surface mainly tuberculate, scar, in dried nutlets, usually curved or twisted, closed, surrounded by an elevated, tuberculate margin.

Distribution: Transition or higher Upper Sonoran Zone in southwestern Colorado and southeastern Utah. Type: "Collected on the Mancos River sage plains in southern Colorado, by Messrs. *Baker, Earle & Tracy,* 8 July, 1898, and distributed under No. *827.*"

Specimens examined:

Colorado: Meeker, June 8, 1902, *Osterhout 2610* (Osterh.); Gunnison, July, 1897, *Bethel* (Colo.); Gunnison Co., June, 1888, *Eastwood* (U.S.); 3 miles south of Ridgway, July 16, 1917, *Payson 1079* (R.Mt., Mo., Gray); Ridgway, June 18, 1924, *Payson & Payson 3834* (R.Mt., Mo., Gray); Dolores, June 16, 1892,

Crandall (N.Y.); Dolores, June 15, 1892, *Herb. Colo. Agric. Coll.* (N.Y.); Mancos, Aug. 11, 1925, *Smith 3936* (R.Mt.); sage plains, Mancos, July 8, 1898, *Baker, Earle & Tracy 827* (Pomona); Mesa Verde, Aug. 2, 1917, *Payson 1135* (R.Mt.); Chimney Rock Mesa, Piedra, June 24, 1924, *Schmoll 1281* (R.Mt., Colo.); Chimney Rock Mesa, Piedra, June 30, 1924, *Schmoll 1346* (R.Mt., Colo.).

Utah: meadow south of Monticello, 1911, *Rydberg & Garrett 9130* (N.Y.).

So far as the material at hand shows, the flowers of this species have only one form. They have the anthers fastened about half way up the tube and the stigma reaches at least to the base of the anthers and possibly higher. The very low position of the anthers makes it seem probable that another form with anthers near the top of the tube will be found. The position of the stigma, however, is that which usually occurs in the species with only one kind of flower.

This species is a very distinct one characterized by the leaves that lack pustulate hairs above, the corolla tube that slightly exceeds the sepals, and the nutlets with a closed scar and an elevated margin.

45. C. mensana (Jones) new comb. Plate 30, figs. 119–121.

Krynitzkia mensana Jones, Contr. West. Bot. **13:** 4. 1910.

Oreocarya mensana (Jones) Payson, Univ. Wyo. Publ. Bot. **1:** 171. 1926.

Rather loosely caespitose perennial; stems several from the base, 8–12 cm. high, sparsely strigose and abundantly white-setose with rather slender bristles; leaves rather broadly spatulate to oblanceolate, 2–7 cm. long, obtuse, lower surface rather sparsely strigose, setose with spreading, slender bristles that are pustulate at the base, upper surface more finely strigose, setae inconspicuous, pustules fewer; inflorescence not greatly exceeding the radical leaves, somewhat open and paniculate, extending over $^3/_4$–$^4/_5$ of the stem, foliar bracts large and well-developed; calyx strigose and conspicuously setose, sepals in anthesis linear-lanceolate, acute, about 4 mm. long, in fruit 7–8 mm. long, exceeding the nutlets by 4–5 mm.; corolla white, tube about 4 mm.

long, equalling or shorter than the sepals in anthesis, crests at the base of the tube nearly but not quite obsolete, fornices probably yellow, less than 1 mm. long, slightly papillose, limb 6–8 mm. broad, lobes united for about ⅓ their length, nearly or quite as long as the tube; fruit very broadly ovoid, 2–4 nutlets maturing (in the material examined), style exceeding the nutlets 1.5–2 mm.; nutlets lanceolate, obtuse, 3–3.5 mm. long, margins usually obtuse, definitely separated by an interval in the material examined, surfaces of nutlets dull or somewhat glossy, the dorsal conspicuously but rather openly muricate, tuberculate and rugose, somewhat ridged down the median line, not foveolate, the ventral surface conspicuously tuberculate, scarcely muricate or rugose, scar open and very conspicuous, surrounded by a high elevated margin.

Distribution: Upper Sonoran Zone in south-central Utah. Type: Emery, May 16, 1894, *M. E. Jones 5445p.*

Specimens examined:

Utah: Emery, June 16, 1894, *Jones 5445p* (Pomona, TYPE, U.S.); San Rafael Swell, May 15, 1914, *Jones* (Pomona).

C. mensana is certainly most closely related to *C. flavoculata* but is probably well worthy of specific rank. The short corolla tubes serve to distinguish it definitely from that species. In addition it is of characteristic habit due to the short stems.

46. C. flavoculata (A. Nels.) new comb. Plate 30, figs. 122–124.

Oreocarya flavoculata A. Nels. Erythea **7:** 66. 1899.

O. flavoculata spatulata A. Nels. Erythea **7:** 67. 1899. (Type: from gravelly hill tops near Evanston, Wyoming, *Nelson 2977*, May 29, 1897.)

O. cristata Eastw. Bull. Torr. Bot. Club **30:** 244. 1903. (Type: Grand Junction, Colo., May 17, 1892, *Eastwood.*)

O. Shockleyi Eastw. Bull. Torr. Bot. Club **30:** 245. 1903. (Type: Miller Mountain, Esmeralda Co., Nevada, elev. 7500 ft., *Shockley 244.*)

O. Eastwoodae Nels. & Kennedy, Muhlenbergia **3:** 141. 1908. (Type: Mormon Mts., Lincoln Co., Nevada, *P. B. Kennedy & L. N. Goodding 146.*)

Caespitose perennial from a woody root; stems few to many

from the base, rather slender, 10–30 cm. high, strigose and densely setose with rather slender bristles; leaves linear-oblanceolate to spatulate, usually obtuse but sometimes acute, 3–8 cm. long, densely strigose and, usually, rather weakly setose, abundantly pustulate on dorsal surface, ventral surface sometimes silky-strigose and quite lacking in pustulate setae, sometimes as densely pustulate as on the dorsal surface; inflorescence continuous or somewhat interrupted, rather narrow, usually extending over upper ½ or ⅔ of the stem, densely but rather weakly and softly setose, foliar bracts not conspicuous; calyx densely setose and strigose, sepals in anthesis linear-lanceolate, acute, about 5 mm. long, in fruit lanceolate or broader, acuminate, often spreading in age, 8–10 mm. long, exceeding the nutlets 5–7 mm.; corolla white or pale yellow, tube 7–10 mm. long, exceeding the sepals in anthesis by 1.5–3 mm., crests at the base of the tube lacking, fornices conspicuously yellow, rather narrow, long (about 1.5 mm.), slightly papillose, limb 8–12 mm. broad, lobes united for about ⅓ their length, ½ to ⅔ as long as the tube; fruit very broadly ovoid, all four nutlets commonly maturing, style exceeding the nutlets 4–8 mm. (species moderately heterostyled); nutlets lanceolate to ovate, mostly obtuse, 2.5–3.5 mm. long, margins usually obtuse, in contact or separated by a definite interval; surfaces of nutlets somewhat glossy, the dorsal muriculate, tuberculate and usually more or less rugose, sometimes almost foveolate, the ventral surface conspicuously tuberculate, scarcely muriculate, rarely rugose, scar open and very conspicuous, surrounded by a high elevated margin.

Distribution: Upper Sonoran and Transition Zones, Wyoming, western Colorado, Utah, Nevada, except the northern third, and southeastern California. Type: Piedmont, Wyoming, June 7, 1898, *A. Nelson 4572*.

Specimens examined:

Wyoming: Trapper Canyon, Big Horn Co., April 20, 1926, *Finley 2* (R.Mt.); Cummins, Albany Co., July 29, 1895, *Nelson 1511* (Mo.); Cooper Creek, June 6, 1898, *E. Nelson 4337* (R.Mt., Mo., U.S., Gray); hills of the Platte in the Rocky Mountains, *Nuttall* (Phila.); Cooper Creek, Albany Co., June 18, 1892, *Buffum 642* (R.Mt.); Hanna, Carbon Co., June 17, 1920, *Payson*

& Payson 1689 (R.Mt., Mo., Gray); Ft. Steele, June 18, 1898, *Nelson 4815* (R.Mt., Mo., U.S.); Ft. Steele, May 25–June 10, 1901, *Tweedy 4259* (U.S.); Point of Rocks, June 17, 1901, *Merrill & Wilcox 457* (R.Mt., U.S., Gray); Point of Rocks, June 15, 1898, *Nelson 4750* (R.Mt.); Steamboat Mt., June 9, 1900, *Nelson 7090* (R.Mt., Pomona, Minn., Mo., U.S., Gray); plains between Eden and Big Piney, July 6, 1922, *Payson & Payson 2583* (R.Mt., Mo.); Green River, June 23, 1896, *Jones 6726* (Pomona); between Evanston and Rock Springs, June 28, 1922, *Osterhout 6252* (R.Mt.); Granger, June 13, 1898, *Nelson 4749a* (R.Mt.); Kemmerer, June 1, 1907, *Nelson 9028* (R.Mt., Minn., Mo., Gray); Cokeville, June 11, 1898, *Nelson 4665* (R.Mt.); Carter, June 9, 1898, *Nelson 4616* (R.Mt.); Piedmont, June 7, 1898, *Nelson 4572* (R.Mt., TYPE, Field); Ft. Bridger, 1873, *Parry 49* (Gray); Evanston, June 4, 1898, *Nelson 4513* (R.Mt., U.S., Gray).

Colorado: south of Yampa River, Moffat Co., June 21, 1922, *Osterhout 6194* (R.Mt.); McCoys, Eagle Co., June 14, 1903, *Osterhout 2850* (R.Mt., Osterh.); Glenwood Springs, June 8, 1920, *Osterhout 5956* (R.Mt., U.S., Gray, Osterh.); Glenwood Springs, June 23, 1912, *Osterhout 4696* (R.Mt., Osterh.); Atchee, May 27, 1908, *Jones* (Pomona); Mack, May 27, 1908, *Jones* (Pomona); Grand Junction, June 11, 1920, *Osterhout 6006* (R.Mt., U.S., Gray, Osterh.); Westwater, May 6, 1891, *Jones 6715* (Pomona); Grand Junction, May 17, 1892, *Eastwood* (Calif.); Naturita, June 20, 1924, *Payson & Payson 3865* (R.Mt., Mo., Gray); 10 miles northeast of Nucla, Montrose Co., June 22, 1924, *Payson & Payson 3874, 3875* (R.Mt., Mo., Gray); near mouth of Tabeguache Creek, Montrose Co., June 6, 1917, *Payson 997* (R.Mt.); Naturita, April 22, 1914, *Payson 246* (R.Mt., Minn., Field, Mo., Gray); east of Montrose, June 15, 1915, *Payson 670* (R.Mt., Gray); near Montrose, July 10, 1917, *Payson 1046* (R.Mt.,); Naturita, May 22, 1914, *Payson 337* (R.Mt., Minn., Field, Mo., Gray, Colo.).

Utah: Uinta Mts., July, 1869, *Watson 852* (Gray); Brush Creek Canyon, Uinta Mts., July 7, 1902, *Goodding 1282* (R.Mt., Gray); low hills east of Bear Lake, June 16, 1922, *Gilbert* (R.Mt.); north of Duchesne, June 22, 1922, *Osterhout 6197* (R.Mt.); Theodore, May 12, 1908, *Jones* (Pomona); Robinson, June 26,

1909, *Jones* (Pomona); Dragon, May 25, 1908, *Jones* (Pomona); Frisco, June 25, 1880, *Jones 6720* (Pomona); Milford, June 19, 1880, *Jones 6721* (Pomona); Thistle Junction, June 10, 1900, *Stokes* (Calif.); bluffs near Price, June 12, 1900, *Stokes* (Minn., U.S.); Cottonwood, Johnson's Pass, Tooele Co., June 6, 1900, *Jones 6677* (Pomona); Glenwood, 5500 ft., May 22, 1875, *Ward 87* (U.S., Gray); Fish Springs, June 4, 1891, *Jones* (Calif., U.S.); Sink Valley, Kane Co., June 23, 1890, *Jones 6678* (Pomona); Deep Creek, western Utah, June 6, 1891, *Jones* (Pomona); Salina, Exp. Station, Fishlake Forest, May 26, 1915, *Eggleston 11118* (U.S.); Cedar City, May 8, 1894, *Jones 5204l* (Pomona, U.S., in part); San Pitch Mts., June 24, 1908, *Tidestrom 1293* (U.S.).

Nevada: Sprucemont, July 21, 1891, *Jones 6715* (Pomona); Aurum, June 20, 1893, *Jones* (Pomona, Mo.); Aurum, July 5, 1905, *Jones* (Pomona); Furber, June 9, 1891, *Jones 6717* (Pomona); Ferguson Spring, June 14, 1900, *Jones* (Pomona); Osceola, June 26, 1906, *Jones* (Pomona); between Austin and Big Creek ranch, Lander Co., July 26, 1913, *Kennedy 4519* (Mo., Phila.); between Austin and Carter's ranch, July 27, 1913, *Hitchcock 755* (U.S.); Mormon Mts., Lincoln Co., July, 1906, *Kennedy & Goodding 146* (R.Mt., Mo., U.S.); east of Carson Lake, June 4, Lieut. Bryan's Exp. (Mo.); White Mts., near Sunland, Mineral Co., June 25, 1912, *Heller 10508* (Mo., U.S., Gray); Miller Mt., Esmeralda Co., 7500 ft., May & June, *Shockley 244* (Calif.); rocky soil, Palmetto Range, May–Oct. 1898, *Purpus 5869* (Calif., U.S.); Kyle Canyon, Charleston Mts., May 25, 1919, *Tidestrom 9610* (Mo.).

California: Summit, Owen's Valley, May 22, 1897, *Jones 6729* (Pomona, U.S.); Inyo Mts., June 25, 1891, *Coville & Funston 2151* (U.S.).

This species certainly possesses a number of different forms but so far they have seemed unworthy of named segregation from the main specific complex. Further study may develop some characters that will serve for varietal distinctions but at present these have not been found.

In western Colorado, near Naturita, the author is familiar with two forms, on a basis of setose-hispid and silky-strigose

indument. For a limited locality it would seem that these two forms are even worthy of specific rank but on examination of a large series of specimens it appears that the differentiation is only local. *Oreocarya cristata* Eastwood has very narrow leaves and so has a slightly different aspect. Osterhout's *6006* seems to be a good match for the type of *cristata*. *O. Shockleyi* is also characterized by narrow, acute leaves. In general appearance the collection from the Mormon Mts. by Kennedy and Goodding is very similar to the type collection of *O. Shockleyi*, nor can the author see that the nutlets are different.

The difference between the stamen insertion in the two forms of the flowers is probably never more than 3 mm. and is usually less than that.

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Austin, S. W.
— (**5**) *C. confertiflora.*
Bailey, V.
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Bentley, Georgia H.
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— (**10**) *C. nubigena.*
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Cockerell, T. D. A.
— (**1e**) *C. Jamesii* var. *typica.*
Colo. Agr. College Herb.
— (**44**) *C. Bakeri.*
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— (**10**) *C. nubigena;* — (**20**) *C. thyrsiflora.*
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— (**20**) *C. thyrsiflora.*
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Hitchcock, A. E.
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— (**1e**) *C. Jamesii* var. *typica.*
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Johnston, I. M.
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Kelsey, F. D.
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Kunze, R. E.
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— (**31**) *C. Bradburiana.*
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Nelson, E. W.
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Explanation of Plate

Figures illustrating nutlets of *Cryptantha*, section *Oreocarya*. Each one is illustrated by three figures—a dorsal, lateral, and ventral view. All are drawn to scale, times 10, except fig. 4 of pl. 25 (complete fruit), which is times 7½.

PLATE 25

Figs. 1–4. *C. Jamesii* var. *multicaulis*. Drawn from *Wooton 401*. The nutlets of all the varieties of *C. Jamesii*, *C. pustulosa*, and *C. Palmeri* are very similar, and these figures will serve to illustrate them.

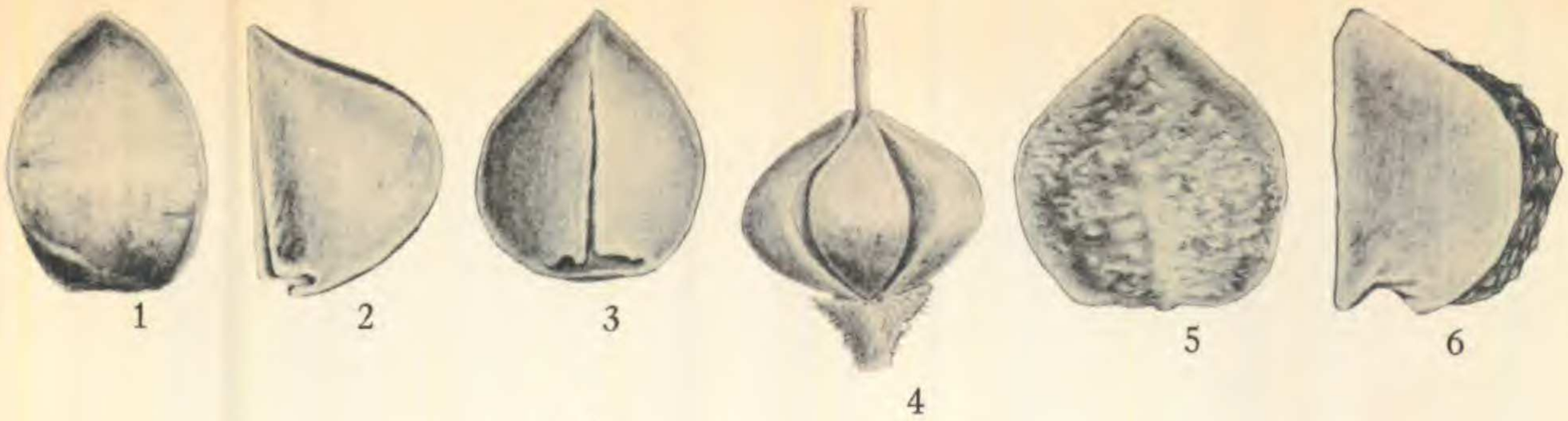
Figs. 5–7. *C. oblata*. Drawn from *Jones 3759*.

Figs. 8–10. *C. confertiflora*. Drawn from *Goodding 814*.

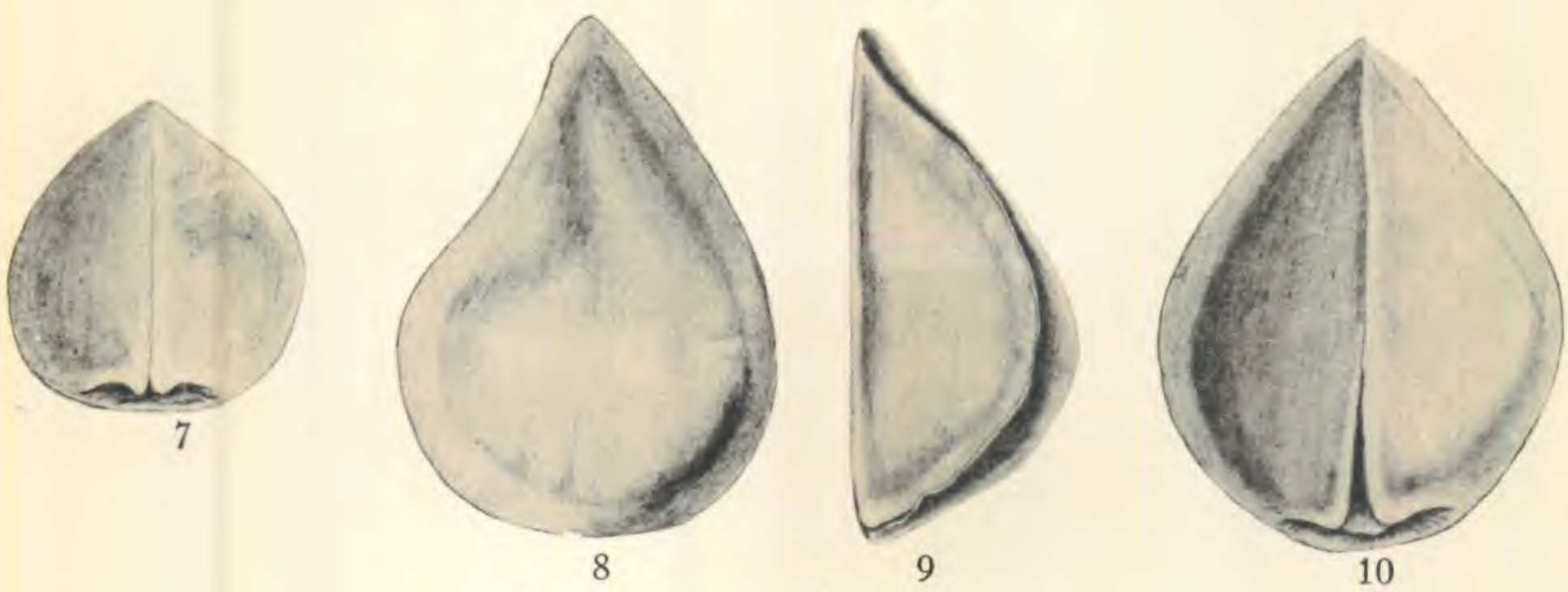
Figs. 11–13. *C. flava*. Drawn from *Goodding 164*.

Figs. 14–16. *C. leucophaea*. Drawn from *Sandberg & Leiberg 373*.

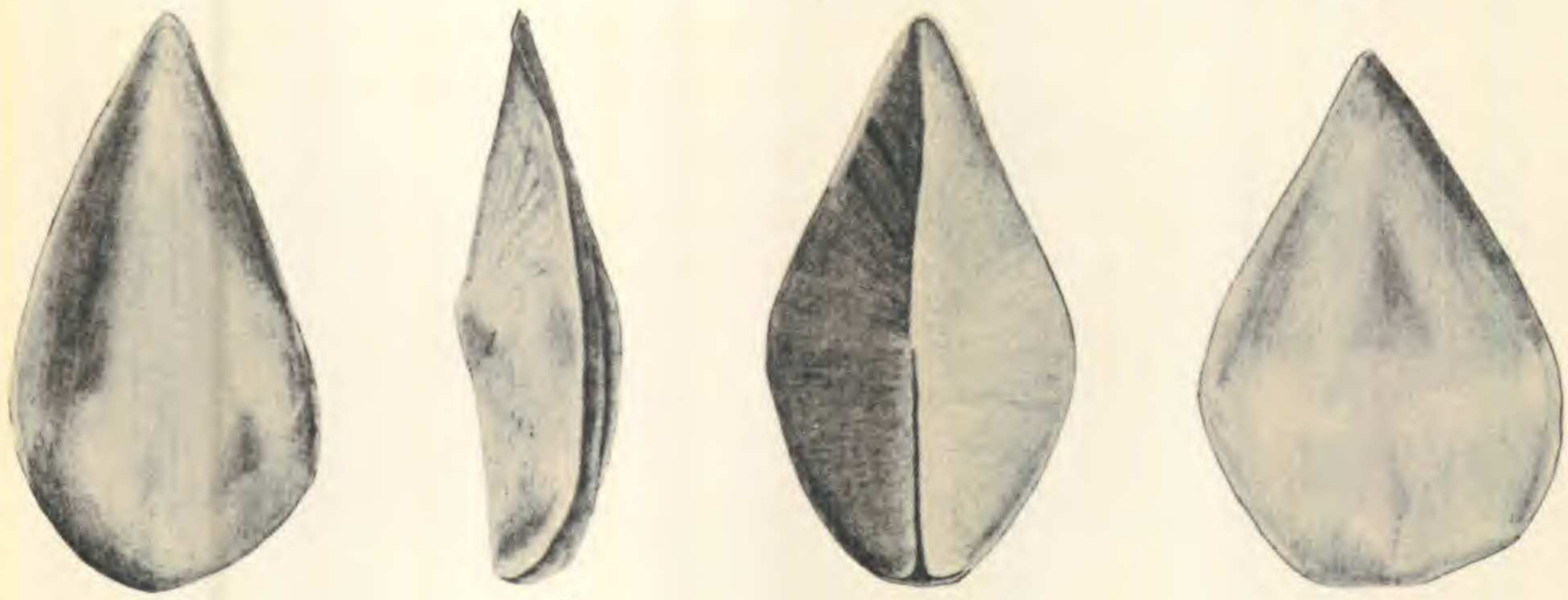
Figs. 17–19. *C. salmonensis*. Drawn from *Payson & Payson 1880*.



1 2 3 4 5 6



7 8 9 10



11 12 13 14



15 16 17 18 19

PAYSON—SECTION OREOCARYA OF CRYPTANTHA

COCKAYNE, BOSTON

Explanation of Plate

PLATE 26

Figs. 20–22. *C. stricta.* Drawn from *Osterhout 6195.*

Figs. 23–25. *C. nubigena.* Drawn from specimen collected by *Cusick*, Pine Creek, Oregon.

Figs. 26–28. *C. Clemensae.* Drawn from type, *Clemens*, Glenn's Pass, California.

Figs. 29–31. *C. setosissima.* Drawn from specimen collected by *M. E. Jones*, Flagstaff, Arizona, August 4, 1884.

Figs. 32–34. *C. virgata.* Drawn from specimens collected near Laramie, Wyoming, by the author in 1925.

Figs. 35–37. *C. insolita.* Drawn from specimen collected by *K. Brandegee*, Las Vegas, Nevada.


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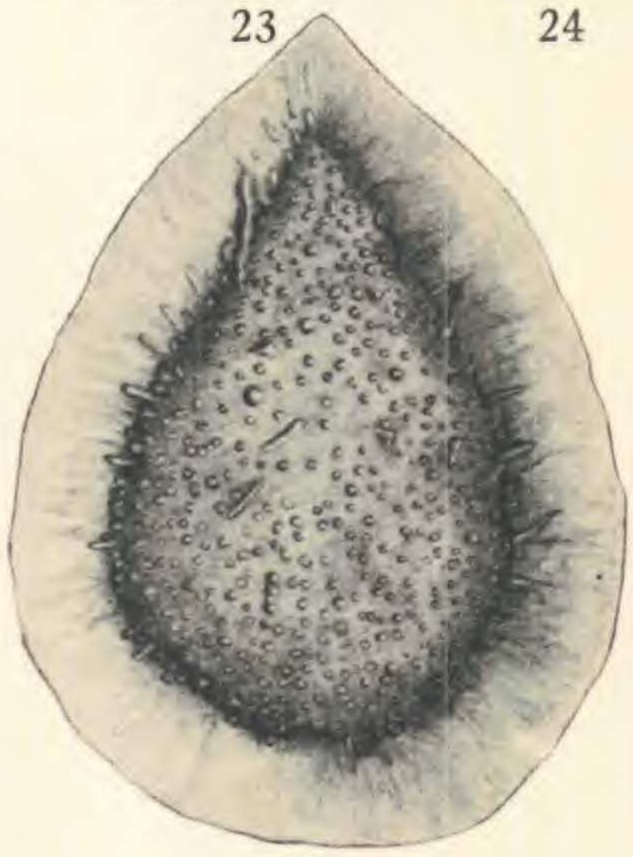

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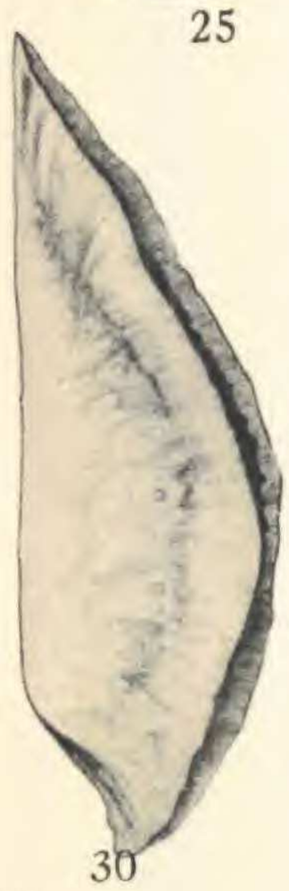

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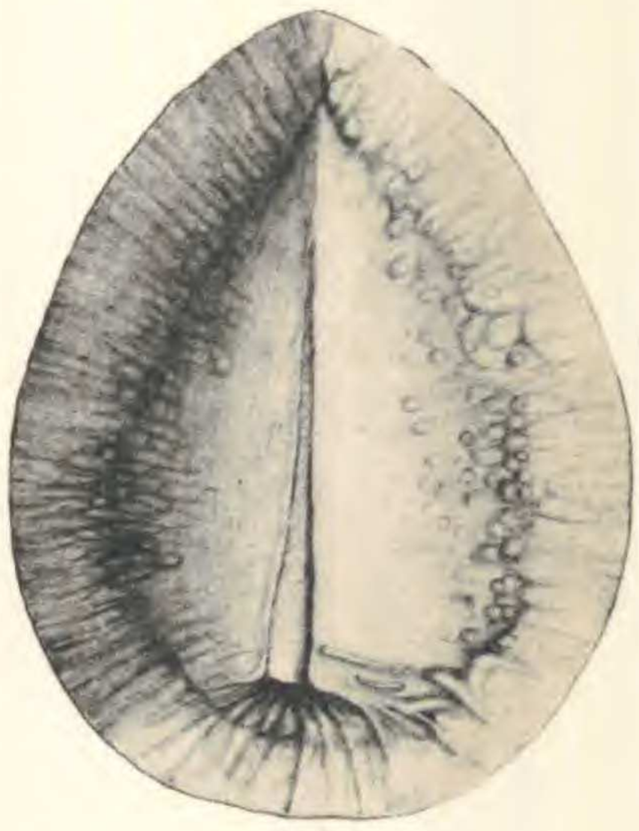

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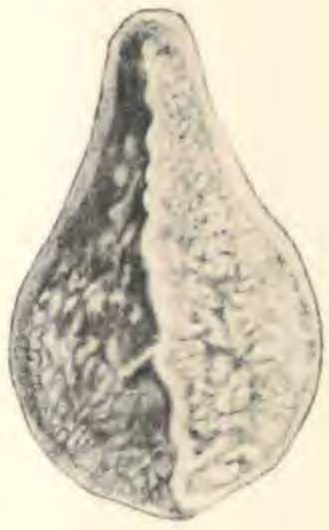

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PAYSON—SECTION OREOCARYA OF CRYPTANTHA

COCKAYNE, BOSTON

Explanation of Plate

PLATE 27

Figs. 38–40. *C. virginensis.* Drawn from *M. E. Jones 5195 a.*

Figs. 41–43. *C. tumulosa.* Drawn from type, *T. S. Brandegee,* Providence Mountains, California.

Figs. 44–46. *C. modesta.* Drawn from type, *Jones 6692,* Aurum, Nevada.

Figs. 47–49. *C. humilis.* Drawn from specimen collected by *Sonne,* along the Truckee River, at Verdi, California.

Figs. 50–52. *C. caespitosa.* Drawn from *Payson & Payson 2578.*

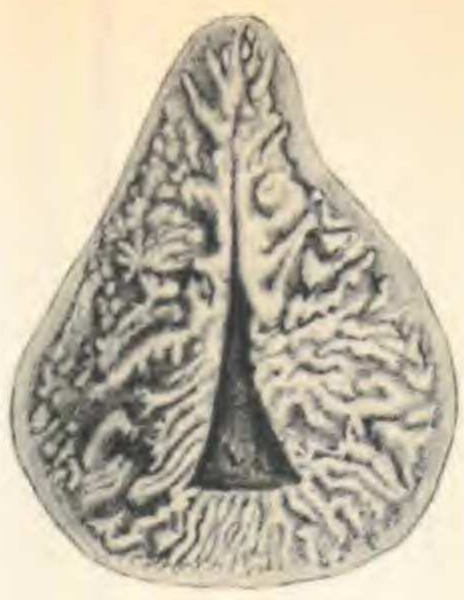
Figs. 53–55. *C. thyrsiflora.* Drawn from *Osterhout 4979.*



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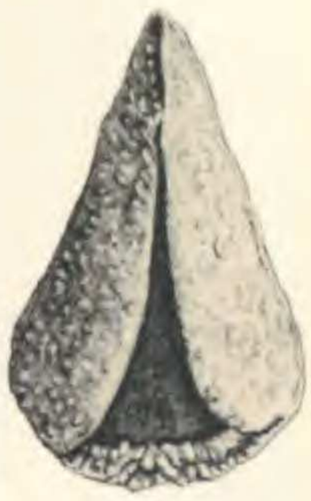
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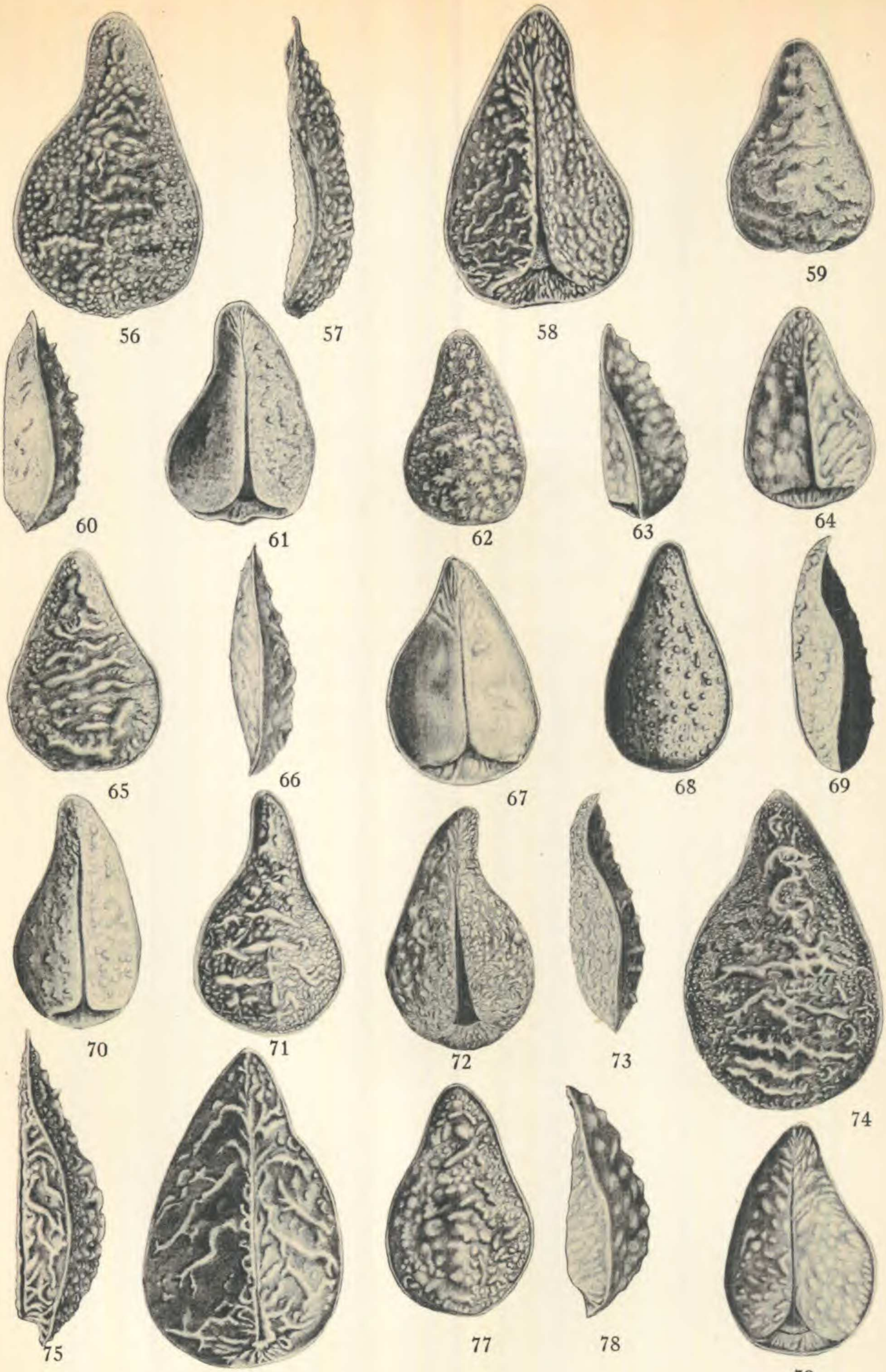
PAYSON—SECTION OREOCARYA OF CRYPTANTHA

COCKAYNE, BOSTON

EXPLANATION OF PLATE

PLATE 28

Figs. 56–58. *C. elata.* Drawn from *Osterhout 5996.*
Figs. 59–61. *C. sericea* var. *typica.* Drawn from *Payson & Payson 2528.*
Figs. 62–64. *C. aperta.* Drawn from type, *Eastwood,* Grand Junction, Colorado.
Figs. 65–67. *C. rugulosa.* Drawn from type, *M. E. Jones,* Fish Springs, Utah.
Figs. 68–70. *C. interrupta.* Drawn from *Heller 9185.*
Figs. 71–73. *C. spiculifera.* Drawn from type, *Sandberg & Leiberg 164.*
Figs. 74–76. *C. celosioides.* Drawn from *Suksdorf 888.*
Figs. 77–79. *C. Sheldonii.* Drawn from type, *Sheldon 8315.*



PAYSON—SECTION OREOCARYA OF CRYPTANTHA

COCKAYNE, BOSTON

EXPLANATION OF PLATE

PLATE 29

Figs. 80–82. *C. Macounii.* Drawn from specimen collected by *Macoun,* at Moose Jaw, Saskatchewan.

Figs. 83–85. *C. sobolifera.* Drawn from type, *M. E. Jones,* Upper Marias Pass, Montana.

Figs. 86–88. *C. Bradburiana.*

Figs. 89–91. *C. nana* var. *Shantzii.* Drawn from type of *Oreocarya dolosa, C. P. Smith 1605.* The nutlets of *C. breviflora, C. fulvocanescens,* and *C. echinoides* are similar to those of *C. nana* var. *Shantzii.* The differences are noted in the descriptions.

Figs. 92–94. *C. cana.* Drawn from type, *A. Nelson 8309.*

Figs. 95–97. *C. propria.* Drawn from *Leiberg 2223.*

Figs. 98–100. *C. Jonesiana.* Drawn from type, *Jones,* San Rafael Swell, Utah.


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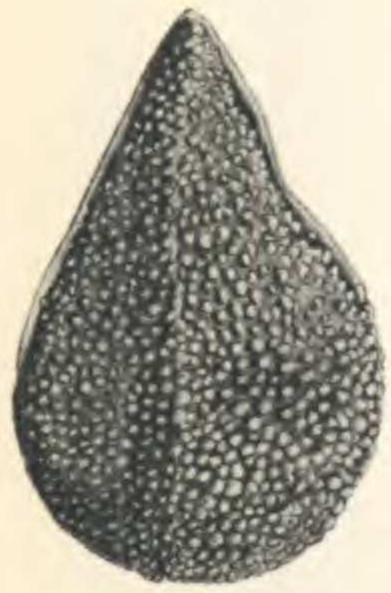

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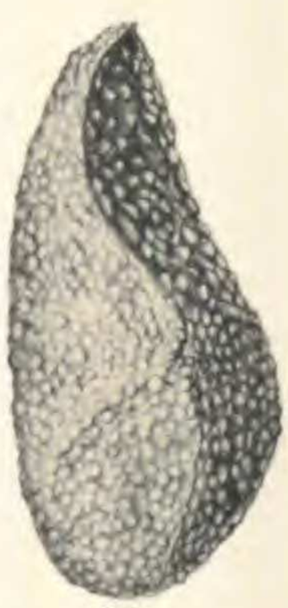

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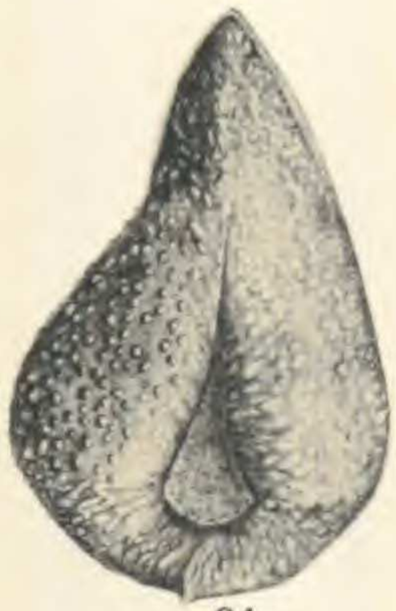

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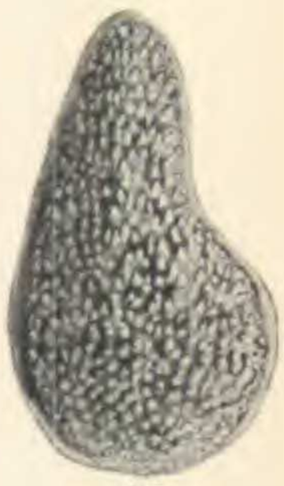

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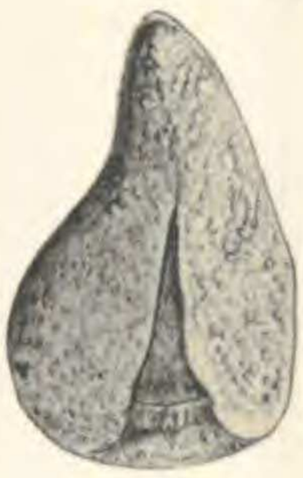

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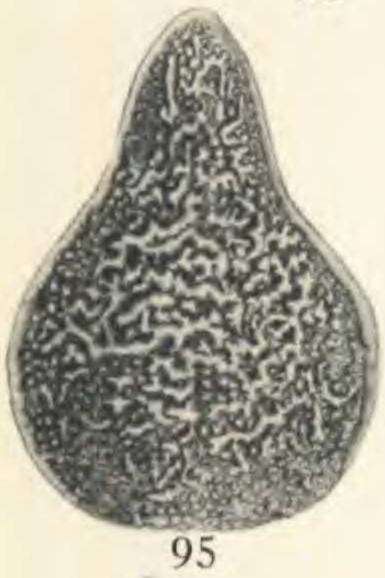

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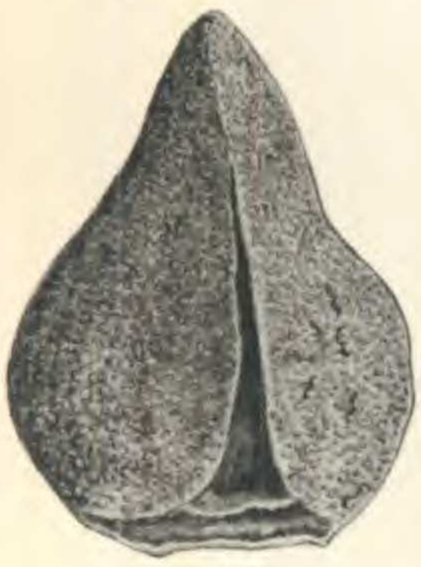

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PAYSON—SECTION OREOCARYA OF CRYPTANTHA

COCKAYNE, BOSTON

Explanation of Plate

PLATE 30

Figs. 101–103. *C. Wetherillii.* Drawn from type, *Eastwood*, Court House Wash, Utah.
Figs. 104–106. *C. longiflora.* Drawn from *Payson 659.*
Figs. 107–109. *C. tenuis.* Drawn from specimen collected by *Purpus.*
Figs. 110–112. *C. Osterhoutii.* Drawn from type, *Osterhout 6138.*
Figs. 113–115. *C. paradoxa.* Drawn from *Payson & Payson 4223.*
Figs. 116–118. *C. Bakeri.* Drawn from *Payson & Payson 3834.*
Figs. 119–121. *C. mensana.* Drawn from type, *Jones 5445 p.*
Figs. 122–124. *C. flavoculata.* Drawn from *Payson & Payson 2583.*